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ABSTRACT

This guide, the second in a series of three, provides the intermediate science student and teacher an opportunity to review selected science concepts and processes through activities which emphasize the applicability of scientific knowledge in the professional world. The guide is divided into three components. The first component helps students understand the relationship of science to careers in health by (1) discussing the role of chromosomes in our genetic makeup and the professionals who work in the field, (2) contrasting inherited and acquired characteristics, and (3) describing how the scientific principles of inherited characteristics are used by health workers. In the second component, students can examine the effects of soil erosion, weathering, and flooding through narratives about the activities of workers in agriculture and natural resources. The third component details those professions that are directly related to the environment. The activities in each of the components reinforce the student's skills in processes such as classifying, interpreting data, and controlling variables. Each activity contains an objective, key words, and a listing of materials needed to complete the learning experience. Simple experiments that students can perform have been included when applicable. In addition, the teacher is provided with a step-by-step outline of suggestions on how to implement the activity. An optional section in each component entitled "Home and Community" provides projects for extending the skills and knowledge gained to those areas. (NCR)

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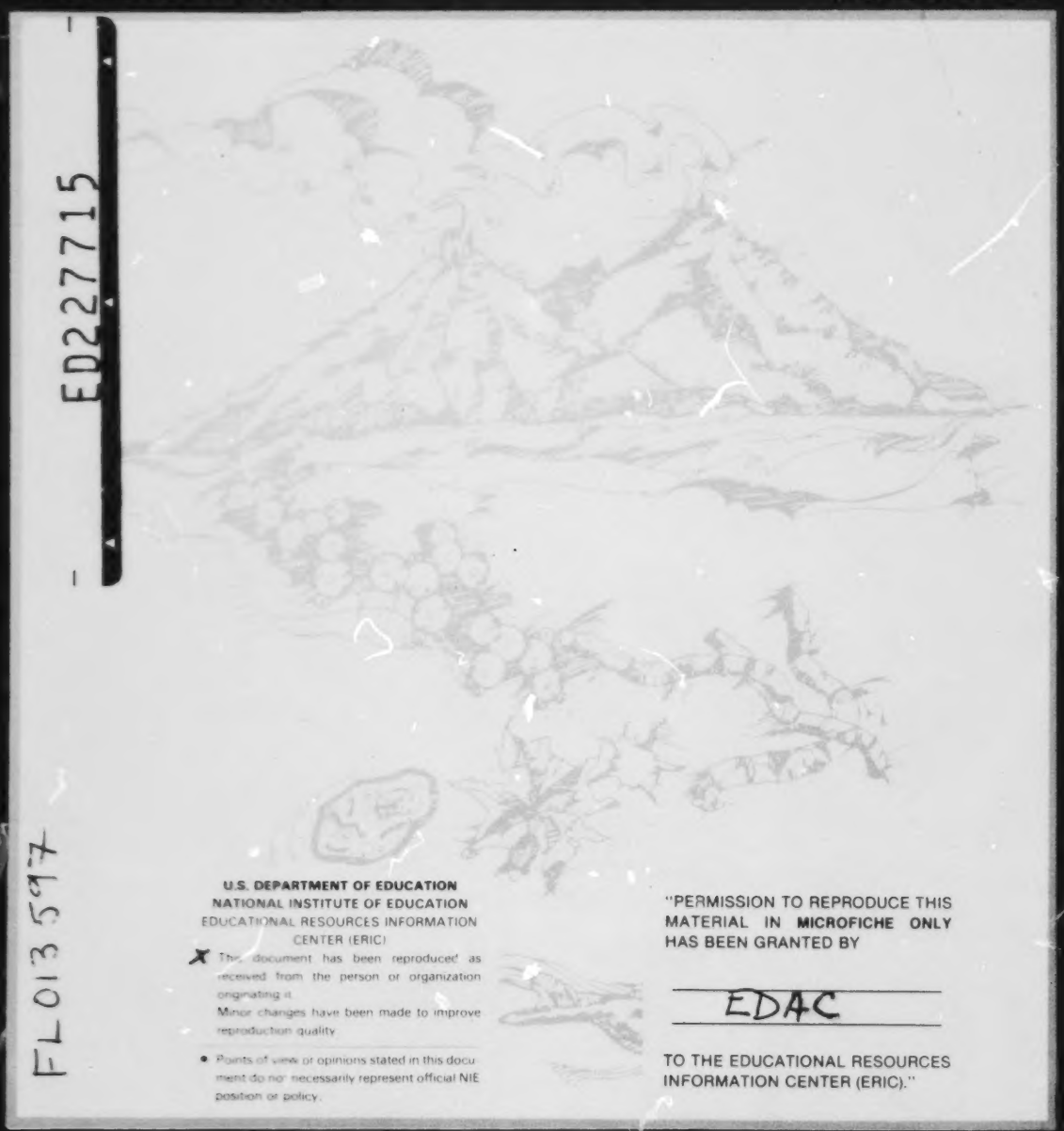
APPLIED BASIC CURRICULUM SERIES

Science

a practical view

Teacher Edition

Volume II



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INSTRUCTIONAL APPROACH

Science: A Practical View provides the intermediate science student and teacher an opportunity to review selected science concepts and processes through activities which emphasize the applicability of scientific knowledge in the professional world. The three activities in each of the three components reinforce the student's skills in processes such as classifying, interpreting data, and controlling variables. Each activity contains an objective, key words, and a listing of materials needed to complete the learning experience. Simple experiments that students can perform have been included when applicable. In addition, the teacher is provided with a step-by-step outline of suggestions on how to implement the activity. An optional section entitled Home and Community provides projects for extending the skills and knowledge gained to those areas. Since the components are independent and interchangeable, the teacher may select those which best meet the needs of the students. They may be presented as they are structured or reordered in another manner. The content also affords students with insight into his or her personal interests and abilities as they relate to preparation for the future. It is hoped that educators will find the materials helpful and motivational.

Component 1

Section One

Section Two

Section Three

CLASSIFYING

OVERVIEW

All of the activities in this component help students understand the relationship of science and careers in the Health Cluster. The first component focuses on the role of chromosomes in our genetic make-up and the professionals who work in this field. The second component contrasts inherited and acquired characteristics. The third component, students are given the opportunity to understand how scientific principals of inherited characteristics are used by workers in the Health Cluster.

GOALS

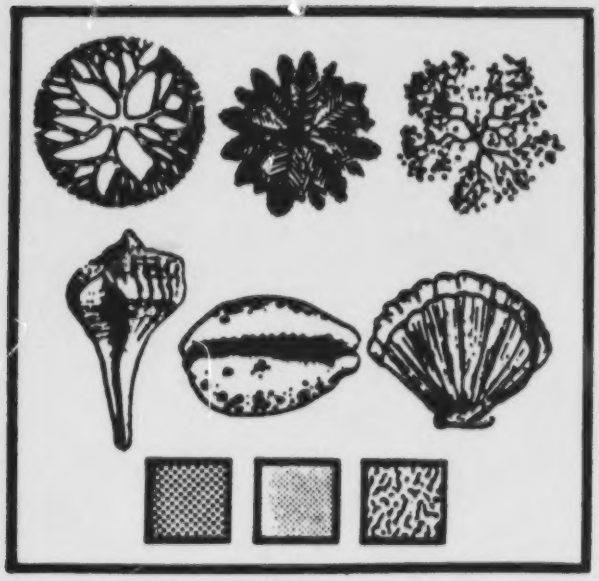
CLASSIFYING:	The students will relate science concepts concerned with the major principals of the chromosome theory to selected occupations in Health
DEFINING OPERATIONALLY:	The students will internalize the importance of science concepts in personality traits.
CONTROLLING VARIABLES:	The student will relate theories of inherited and acquired characteristics to jobs in the Health Cluster.

LEARNING SECTIONS

Section 1: *Patty's Problem*

Section 2: *Heredity or Environment?*

Section 3: *A Visit to Johnson Middle School?*



COMPONENT I

Section One

Section One
Patty's Problem

Learning Objective

Given a narrative and a worksheet with emphasis on selected careers in Health, the student will list the qualifications of different workers and answer questions about the chromosome theory as it relates to careers in science with 70% accuracy.

Key Words

- genes
- chromosomes
- geneticist
- inherit

Domains and Levels

Cognitive : Knowledge, Comprehension, Application

Affective : Receiving, Responding

Materials

- copies of the narrative
- copies of the worksheet
- evaluation

IMPLEMENTATION GUIDELINES

Time: *1 Class*

STEP I - The teacher should initiate a class discussion about the relationship of careers in health and the study of science. He or she may then direct the discussion toward inherited characteristics, explaining the meaning of the key words.

STEP II - The teacher may ask the students if they are familiar with the Down's Syndrome and explain that this is the subject of the narrative they will read.

STEP III - The students may take turns reading the narrative. The teacher may take this opportunity to explain anything they may not understand.

STEP IV - Student may complete the worksheet, sharing their answers with the class.

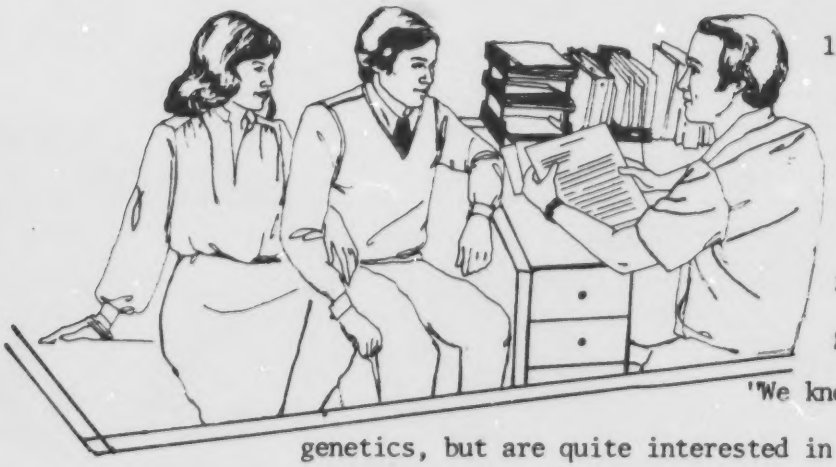
STEP V - The Evaluation

STEP VI - The Home and Community section is optional, to be completed if there is sufficient time.

STUDENT ACTIVITY MATERIAL

Patty's Problem

Juan and Jane arrived at the Medical Center early this morning to get ready for Patty and her family. They needed to complete a work-up on Patty. The rest of the medical team had finished their tests yesterday. Juan, the geneticist, needed to run some blood samples and tests and talk to Patty's parents. He wanted to explain to them what was going to happen as a result of these tests. As Juan and Jane walked into the conference room they were surprised to see Patty and her family already there. Juan introduced himself and asked them to go down the hall to the lab. He said he would be there in just a minute. Jane, who is the medical social worker, told Juan to let her know when they were finished in the lab. She would then come to get Patty and her family. She wanted to take them down to her office and talk to them.



Juan went into the lab and sat down to talk to Patty's parents. He asked them, "How much do you know about genetics and what are we going to do today?"

"We know very little about genetics, but are quite interested in finding out everything we can," replied Patty's dad.

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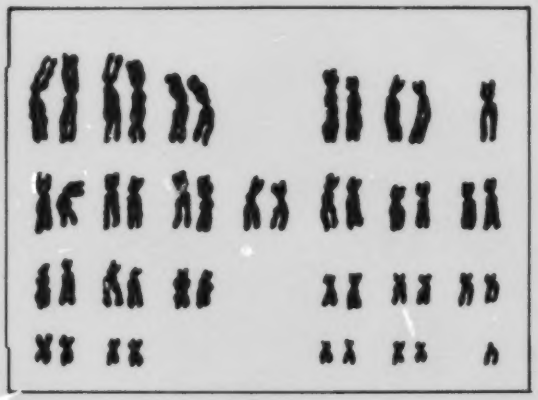
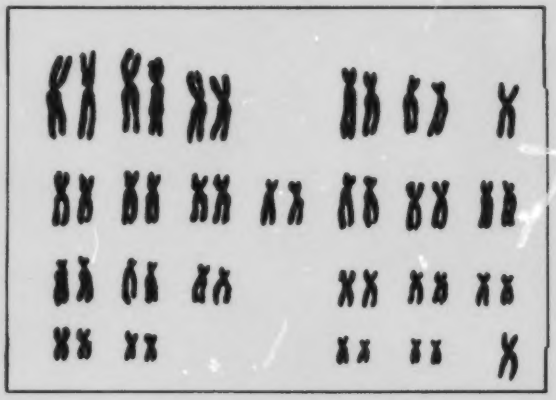
"Well," said Juan, "as a geneticist I study genes, which cause inborn differences in all people. Genes are found in the chromosomes which exist in every cell. They influence the traits and characteristics of every human being, such as hair color, skin color and height. There are a fixed number of chromosomes in every cell. In humans, there are 23 chromosomes in the female seed package and 23 in the male seed package.



Male



Female

This makes up a total of 46 chromosomes. I do research on different biclogical characteristics and factors concerned with heredity. Today, I am going to take some samples of Patty's blood and run some tests on her. These tests will confirm whether she is a Down's Syndrome child or not. Most of the tests we have already run point to this. There are several characteristics that point directly to Down's Syndrome. These are limber muscles, facial features, and slightly enlarged tongue. The reason that most of these children have traits in common is because the same thing goes wrong for most of them. You see, normally, each of the 23 chromosomes of the mother go through a process and make a pair of

chromosomes. Each of the 23 chromosomes of the father do the same. Most of us have 46 chromosomes. But, with Down's Syndrome, there is a breakdown of sorts in the genes, and the chromosomes don't pair correctly. One of the pairs splits up, and it is usually in the same chromosome each time. It looks like this:

Normal

Faulty Pairing

"Some of these children do have traits in common; they also have some inherited from parents, such as different hair color or eye color. Is this fairly clear, or do you have any questions?"

Patty's parents had no questions, so Juan asked them to wait in the hall while he ran some of the tests on Patty. As Patty's parents were waiting in the hall, Mr. Brown told his wife, that the doctor seemed well-informed.

After Juan was through, he and Patty joined her parents in the hallway. Mr. Brown told the doctor he had a very interesting job. He asked him if he had to study a long time to become a geneticist. Juan explained:

"Well, during high school I studied a lot of math and science. Then I went on to college. I received a bachelor's degree after four years

and then got a master's and doctor's degree. All through college I took science and math courses and spent a lot of time in the laboratory. I liked working in the lab alone, doing tests and double checking my experiments. I know the results are very important to a lot of people. Here at the Medical Center I usually work with a professional team of doctors and other medical people. I also have conferences with parents and explain what we do here. A geneticist must like to be with people too."

Mr. Brown said, "I have a son named Joe who likes science and has his own microscope at home. He is always looking at things through it. He is also very good in school. He has a lot of friends, but also likes his time to himself. I'll bet he would be real interested in being a geneticist."

"You tell your son to give me a call, and we will set up a time for him to come up and talk to me if he is interested."

The Browns thanked him for everything. Then Jane walked up to show them to her office for a conference.

She smiled kindly and said:

"I am Jane Miller. I am a medical social worker. I am here mainly to help you in any way I can. I can try to get you services that you might need, or I can refer you to other places to get services that I cannot locate.

If you are having any money or family problems that I may be able to help you with, please speak up."

Mrs. Brown spoke up; she said, "Patty is only four years old, but we really feel that she should be in some sort of program to help her, even at this age. Also, she has very few children to play with. In the summer especially she needs some children that are her own mental age to play with. Do you know of anyone that can help us?"

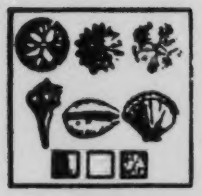
"Since Patty is four years old, you can enroll her in the Independent School District for a summer program. You can call your local Association for Retarded Citizens, and they can help you with that. I will give you that number. Do you have any questions about what caused Patty's retardation or any other aspect of this problem?"

"Yes," said Mrs Brown. "Is it going to be possible for us to have normal children later on?"

"The odds are good that your next child will be perfectly normal, but if you are worried, we can do a test called amniocentesis. This tests the amniotic fluid from the water sac for any genetic problems. This can only tell us problems related to genetics, like Down's Syndrome, but it might be something for you to consider. If you are interested, Juan could go into a more detailed explanation for you."

"How is it that you know so much about this since you are only a social worker?" asked Mr. Brown.

"Well, I studied to be a medical social worker so I could work with people like you. When I was in high school I took biology and found



that I was good in it. I really liked science, but I didn't want to go to school all those years to be a doctor. I wanted to help people in a different way. So when I went to college, I took chemistry, studied about diseases, studied about medicines and their side effects, all along with my sociology studies. I got my master's degree in social work so I could do counseling. So you see, science played a big part in my schooling. I studied about chromosomes and genes, and that has really helped me understand the people I counsel and work with."

Mr. and Mrs. Brown could not thank Jane enough for her information, time, and understanding of their problems. They knew things were going to be better now since they knew of some places where Patty could go for some schooling. They considered their day to be a complete success. The results, no matter what they turned out to be, would be easier for them to take knowing what they did now, and knowing that all was in good hands with the professional team at the Medical Center.

WORKSHEET

Write "medical social worker" or "geneticist" beside each qualification, according to the job it goes with.

1. studied science in high school and college _____
2. uses a microscope _____
3. took sociology courses in college _____
4. studies genes which are found in chromosomes _____
5. needs at least a college degree _____

FILL IN THE BLANKS:

1. When the male and female seed package unite they have _____ pairs of chromosomes.
2. _____ affect hair and skin color.
3. _____ are found in chromosomes.
4. A _____ does research on different biological characteristics and factors concerned with heredity in plants and animals.
5. As a medical social worker, Jane took chemistry and sociology and studied about _____

ANSWER KEY

1. Geneticist or Medical Social Worker
2. Geneticist
3. Medical Social Worker
4. Geneticist
5. Geneticist or Medical Social Worker

1. 23
2. chromosomes
3. genes
4. geneticist
5. diseases or medicines and their side effects

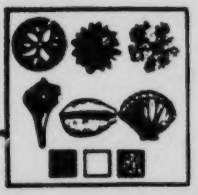
HOME and COMMUNITY

The student may ask his or her parents and brothers and sisters if they know what a geneticist is and what he does. If they are not sure, the student may tell them:

1. A geneticist studies genes, which control inborn differences in people.
2. He or she is a member of the science field and does research in the lab with a microscope and works with people when doing tests.
3. A geneticist went to college for four years and then went on to get at least his master's degree.

The student may then play geneticist and investigate height, weight, eye color, and hair color of his/her brothers and sisters. This information may be organized in chart form for the student's understanding.

EVALUATION



I. List below two qualifications of a geneticist and at least two qualifications of a medical social worker.

GENETICIST

1. _____

_____

2. _____

_____

MEDICAL SOCIAL WORKER

1. _____

_____

2. _____

_____

II. MATCHING:

1. A career in health professions demands a background in _____ .
2. These are found in chromosomes _____ .
3. There are 23 of these in each seed package _____ .
4. Each of the chromosomes goes through a process to make up 23 _____ of chromosomes.
5. Does research on biological characteristics and heredity. _____

genes
science
geneticist
chromosomes
pairs
medical social worker

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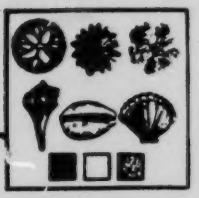

EVALUATION

ANSWER SHEET

Qualifications:

Geneticist - Four years of college and at least a master's degree; background in science and math; must like to do research and work with people.

Medical Social Worker - Four years of college; background in science; courses in sociology; likes to work with people

MATCHING

1. science
2. genes
3. chromosomes
4. pairs
5. geneticist

COMPONENT I

Section Two

Section Two

Heredity or Environment

Learning Objective

Given a case study which emphasizes pleasing personality traits and their relationship to careers in Health, the student will identify those traits, contrasting them with inherited characteristics with 70% accuracy.

Key Words

- environment
- heredity
- personality
- traits

Domains and Levels

Cognitive: Knowledge, Comprehension, Application, Analysis

Affective: Receiving, Responding, Valuing

Materials

- copies of the narrative
- worksheet
- evaluation

IMPLEMENTATION GUIDELINES

Time: *1 Class*

STEP I - The teacher may begin this component with a discussion of those traits which contribute to a "pleasing" personality. The class may be asked to think of a person who has a pleasing personality, and then mention those qualities or traits that make up that personality. Positive traits may include:

kindness	thoughtfulness
generosity	courtesy
patience	friendliness
understanding	open
good listener	attentive
consideration	honesty
sincerity	geniality

STEP II - The teacher may then ask the students which careers in health care might demand a pleasing personality. Students may be guided to the realization that those whose jobs involve contact with others must have a pleasing personality. The teacher may make clear that a pleasing personality is an asset to <u>all</u> careers, however.

STEP III - The teacher may introduce the narrative with a thought - provoking question, such as, "Can you inherit patience from your parents, or is patience a learned behavior? the class may read the narrative aloud or silently.

STEP IV - After the narrative is read the students may answer the questions on the worksheet.

STEP V - Evaluation

STEP VI - The Home and Community Section is optional, to be completed if there is time.

STUDENT ACTIVITY MATERIAL

HEREDITY OR ENVIRONMENT?

For a long time psychologists have been investigating heredity and environment. Psychologists observe the behavior of people and study it to find out why people behave as they do. Originally, they believed that all personality traits were learned, but now some of the psychologists believe that some of these traits may be inherited. Research has not shown which traits are learned and which are inherited, though. Some psychologists argue that because the family unit lives together most traits might be learned from the mother and father and not inherited. Most seem to think that much of our personality is learned and environmental. Let's look at the characteristics of a brother and sister who are very different yet in a lot of ways very much alike. They have both applied for jobs at City Hospital.

George and María López applied today for jobs at City Hospital. George has just finished high school, and María is in her last year. George is very competitive in school and in sports. He is also very ambitious and wants to get a lot out of life. He means to have his way even if it means stepping on people. Even though he is like this, George has a lot of friends. Kids think George is a leader, since he is outgoing and smart and very good in sports. George is a very nice looking boy who attracts girls to him, even though he isn't the most thoughtful or considerate boy in the world. María, on the other hand, is very quiet and thoughtful. She also has a lot of friends. María likes to be with people, as her brother does, but she is kinder and more patient

with others. María is also a good listener. She has done some volunteer work at the hospital on the weekends because she thinks she might want to be a nurse or doctor some day. She wants to see if she really likes it and is good at it. All of the patients really like her, mainly because she is so attentive. She seems to know their needs before they ask.

Mr. Thompson will interview George and María today. He knows that María volunteered at the hospital so she could try and decide what career she was interested in. He called María into his office first. He asked her about her volunteer work. María told Mr. Thompson how much she liked working at the hospital, and he told her that he figured that she would, since she did have the right personality for that kind of work. He told her he would let her know about a part time job very soon.

After Mr. Thompson talked to George for five minutes he saw how different the brother and sister were. George was a charmer and outgoing, but was not very sincere. He didn't seem to really care about people. Mr. Thompson thought how odd it was that a brother and sister could be so different when they had lived in the same family and had been raised the same way. They looked so much alike, but in personality,

they were not alike. He thought about all he had learned in college about genes and heredity and also about environment. He thought what a classic case this was. As far as inherited traits, they looked a lot alike in hair color and eye color, but their personalities were completely different.

Mr. Thompson will take the different personality traits into consideration when he recommends jobs for María and George. María's pleasing personality will mean a good chance of getting and keeping a job. Medical personnel workers like Mr. Thompson try to match the person to the job. They know that pleasant, kind, sincere persons like María work very well with others. What kind of job do you think George can do well?

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WORKSHEET

I. Make a list of the personality traits of George and María. Use the narrative if you need it.

George	María
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

II. The following is a description of two jobs at City Hospital. Which do you think María should have? Put a (✓) in the box.

☐ Nursing Assistant - Doesn't perform technical duties, but must be clean, alert, and attentive. Spends a great amount of time with patients. Must like people and enjoy helping them.

☐ Medical Record Technician - Works with the records kept on every patient in the hospital. Must have a good memory, patience, and the ability to concentrate. Works with data.

III. Write three personality traits you have. How would they help or hinder you in getting and keeping a job?

_____

_____

28 _____

WORKSHEET ANSWERS

I.

George	María
1. competitive	1. quiet
2. ambitious	2. kind
3. leader	3. good listener
4. charming	4. attentive
5. out-going	5. generous

Accept all logical answers

II. María is good with people. Her personality is pleasing. She would receive more satisfaction from being a Nursing Assistant.

III. Accept all logical and honest evaluations of students' personalities

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HOME and COMMUNITY

Students may talk to their parents about personality traits. They may discuss what traits the brothers and sisters have in common or what traits the parents have in common. Remember to talk about the good as well as the bad openly. Also be sure to discuss how different members of your family use the same traits in different ways.

EVALUATION

I. True or false

Write True or False in each blank.

1. All traits are inherited _____
2. Environment plays a very small part in deciding the outcome of our personality_____
3. A doctor knows which traits are inherited and which are acquired. _____
4. A person pursuing a career in health should be patient, considerate and thoughtful with sick people _____
5. María had good qualities to help her enjoy and be good at a career in health _____

II. Below identify traits which are essential to having a pleasing personality by putting a check next to them.

kind	considerate
jealous	aggresive
patient	attentive
friendly	courteous
sincere	snobbish
bad temper	
thoughtful	
honest	
selfish	

EVALUATION

ANSWER KEY

1. false
2. false
3. false
4. true
5. true

All traits should have a check except:

jealous

bad temper

selfish

agressive

snobbish

COMPONENT I
Section Three

Section Three
A Visit to Johnson Middle School

Learning Objective

Given a narrative related to the scientific principles of inherited characteristics and careers in the Health Cluster, the student will analize how these scientific concepts are related to jobs in this cluster with 70% accuracy.

Key Words

- RNA and DNA molecules
- chromosomes
- genes

Domains and Levels

Cognitive: Knowledge, Comprehension, Application, Analysis

Affective: Receiving, Responding

Materials

- copies of narrative
- worksheet
- evaluation

IMPLEMENTATION GUIDELINES

Time: *1 Class*

STEP I - The teacher may introduce this activity with a review of the development and application of chromosome theory, stressing that traits are inherited by offspring in definite predictable patterns.

STEP II - The class may take turns reading the narrative aloud. The teacher should be sure the vocabulary is understood.

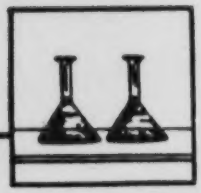
STEP III - After the narrative is read the students may ask any questions they may have about the career information and the scientific concepts. The worksheet may be completed at this time.

STEP IV - The class may grade the worksheet as the teacher reads the answers.

STEP V - Evaluation

STEP VI - The Home and Community section is optional, to be completed if time allows.

STUDENT ACTIVITY MATERIAL



A Visit to Johnson Middle School

Today is a special day at Johnson Middle School. Two people who work at the Oak Cliff Genetic Clinic and coming to speak to the seventh and eighth graders about their jobs in health. A lab technician and a geneticist who work together are the speakers. The principal, Mr. Marcos, first introduced Helen Watson, the geneticist. Dr. Watson explained something about her background.

"I went to college for four years to get my bachelor's degree. I took quite a bit of science and math in high school and college. I went on to get my master's and doctorate because it is hard to get a job without a doctorate..

"I do a lot of research. I really enjoy being alone in the laboratory. Scientific curiosity and logical sequences are very important in research. I have to be determined to come up with the correct answers as so much depends on my results. Even though you work alone a lot of the time, when there is a genetic study to be done, you work with a team of doctors and other professionals. So it is important to get along with them."

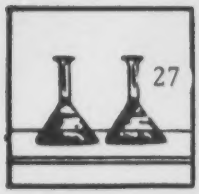
One of the students asked, "Could you please tell us something about genes? We haven't studied a lot about them yet."

"Okay. As you probably know, you started as a tiny seed in your mother, but your mother's seed package had only half of what was needed to make you sprout as a baby. Your father's seed material carried the other half. When the seed-carrying package from your father joined with

the seed package from your mother, the package opened up and began to work together to produce the baby who became you.

If you continue to watch this package under the microscope and stain it with coloring matter, you would see the tiniest imaginable little piece that looks like rubber plastic in different lengths.

This is called a chromosome. In each of the sections there are genes. There are 46 chromosomes, 23 from your mother and 23 from your father. The genes contain the inherited traits from your parents. Each



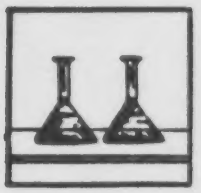
gene has a special job to do to build your brain, skeleton, nervous system and so on. Also, your environment plays a large role in how you grow and develop. Both your heredity and environment are equally important. You see, without human heredity you could have been a cat or kangaroo, but without human environment you would not have learned to behave and think as other human beings do. Does that help in your understanding of genes?"

"Yes, but what do you do?"

"Sometimes, the chromosomes don't link up correctly, and this causes malformations or retardations. I do research to see what went wrong with a child."

After the students had finished talking with the geneticist, Dr. Watson, the principal introduced John Mills, who was the lab technician. He explained:

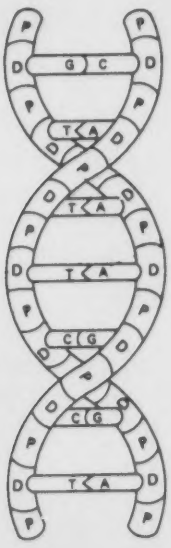
"I went to college right here in this city at Urban Community College. I studied for two years. I took a lot of science, like biology and chemistry, along with the rest of my curriculum. After I graduated, I took a state board exam to be registered. Then I started looking for a job and found one at the Oak Cliff Genetic Clinic. My work there is very interesting, a lot more than if I were doing routine work at a hospital. At the clinic I am in charge of taking the blood samples from the patients and running some of the preliminary tests. I use all different types of microscopes, from the ones like you have in your lab, to a very expensive one called an electron microscope. I really enjoy the time I spend



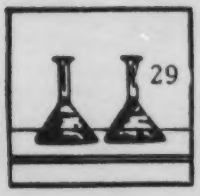
in the lab. It is just what I always wanted to do, to work in a field of science without going to school for years and years."

One of the students asked, "What kind of tests do you run on blood?"

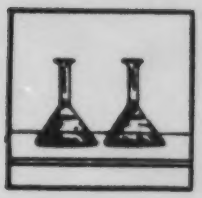
"We do pretty much a complete work-up on blood. We do a complete blood count, which tells us about the make-up of the blood and that tells us if a person is anemic.



"We check for electrolytes to see how well a person can fight infections in the system. The main test that we do at the clinic is done on the electron microscope. This test allows us to look at DNA and RNA chains. Remember when Dr. Watson was talking to you about genes and chromosomes? Well, DNA and RNA are chains that are the genetic make-up of the offspring. They are the minute substances that decide if you are going to have brown or red hair. With our microscope we can look at these chains and see if there is a breakdown in the chain or if there is anything else wrong with them. By doing this, we can determine whether a baby has a good chance to be normal or if there might be problems. Only by knowing what the genes are supposed to look like and studying science can you tell these things. You can see how important it is for you to be right when you go back to your patients with the results of these tests."



There were no more questions. Mr. Marcos thanked the guests, and so did the students. Everyone felt very good about this special presentation since the students not only learned a little more about genes and chromosomes but also how to apply science to health careers.



WORKSHEET

Fill in the blanks:

1. RNA and DNA are the substance that make up _____.
2. Each section of a chromosome contains a _____.
3. There are _____chromosomes in your mother's seed package.
4. Besides genes and chromosomes, _____ plays a big role in how you grow and develop.
5. The microscope that allows us to look at RNA and DNA molecules is called the _____.

Choose the best one:

Geneticist Lab Technician

1. I went to school for two years and then had to pass a state board exam _____
2. I went to college for four years and then got my master's and doctorate degrees_____
3. I work in the lab and also very closely with a team of professional doctors and nurses doing research _____.
4. I work in the lab doing preliminary studies for the geneticist _____ _____.

ANSWER SHEET

1. genes
2. gene
3. 23
4. environment
5. electron microscope

1. Lab Technician
2. Geneticist
3. Geneticist
4. Lab Technician

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HOME and COMMUNITY

The student, with the teacher's help, may invite workers in the field of health to come to the school and speak about what they do and how it is related to science. Students may also survey the class to see what professions most of the class seem to be interested in and try to get someone from that profession.

EVALUATION

I. Matching: Match the following.

1. Makes up the gene.	a. Chromosome
2. Makes up the chromosome.	b. Environment
3. There are 23 of these in your father's seed package.	c. RNA and DNA
4. Plays a large role in development but is not a gene.	d. Science
5. What you must study and know well to be a geneticist, lab technician or almost anything in the health careers.	e. Genes

II. In your own words tell me what you need to know and what you need to study to become a geneticist.

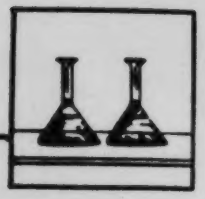
_____

_____

_____

_____

_____



EVALUATION

ANSWER KEY

1. RNA and DNA
2. genes
3. chromosomes
4. environment
5. science

Essay:

The student needs to touch on the fact that the geneticist should have studied a lot of science, have curiosity about scientific principles, and be able to work with people as well as enjoy time alone in the lab. Also they should mention that he should be a good student, since it takes quite a few years in college to become a geneticist.

Component 2

Section One

Section Two

Section Three

SOIL EROSION, WEATHERING AND FLOODING

OVERVIEW

These materials provides the student with an opportunity to observe scientific principles in action. Through narratives about the activities of workers in the Agribusiness and Natural Resources Cluster, the students can examine the effects of soil erosion, weathering, and flooding. The components are intended to foster a positive attitude toward proper use and conservation of our natural resources.

GOALS

OBSERVING:	The student will develop a narrative applying scientific knowledge of natural processes to a practical problem related to careers in Agribusiness and Natural Resources.
HYPOTHESIZING:	The student will identify jobs in agriculture and natural resources with working conditions, and the use of scientific knowledge related to these jobs.
FORMULATING MODELS:	Students will apply scientific principals of soil composition to a given situation.

LEARNING SECTIONS

Section 1: *Down to Earth Jobs*

Section 2: *An Unfinished Story*

Section 3: *Working with the Earth*

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COMPONENT II

Section One

Section One
Down to Earth Jobs

Learning Objective

Given a set of job descriptions and working conditions concerning agriculture and natural resource occupations which emphasizes change processes, the student will identify the proper job title and then match the working condition to the proper title with 70% accuracy.

Key Words

. laboratory
. organic
. inorganic
. stripcropping
. irrigation
. weathering
. erosion
. particles
. decomposition
. soil
. geology
. layers
. engineer

Domains and Levels

Cognitive : Knowledge, Comprehension, Analysis

Affective : Receiving, Responding

Materials

. sufficient copies of 4 job descriptions

. sufficient copies of the student worksheet

. sufficient copies of the evaluation sheet

IMPLEMENTATION GUIDELINES

Time: *45 Minutes*

STEP I - The teacher may introduce this activity by reviewing the effects of change processes such as weathering, erosion, and decomposition. It may be brought out in the review that various careers in the Agribusiness and Natural Resources Cluster have to do with these processes. The Key Words may be reviewed at this time, and the teacher may discuss technical terms such as stripcropping, contour plowing, crop rotation, and decomposition.

STEP II - The material may be read on an individual basis or by the teacher. The Worksheet may then be completed.

STEP III - Following the completion of the activity the teacher should engage the students in a discussion of the activity and the means by which they were able to find the clues which allowed them to identify the proper job title.

STEP IV - Evaluation

STEP V - The Home and Community activity is optional and may be assigned if there is sufficient time.

STUDENT ACTIVITY MATERIAL

Testing Soils

Amalese Washington likes her work in the laboratory. Amalese works with soil. She tests soil to see if the process of soil building needs to be helped, or if the process of soil erosion needs to be stopped. Soil is made from both weathering and non-living things, as well as the decomposition of living things. Amalese must know about geology and chemistry. She must know how plants and animals decompose to make the organic matter found in soil. She also has to study rocks to understand how weathering breaks rocks down into the inorganic matter found in soil.

Farmers and ranchers bring Amalese samples of their soil to test. She compares the amount of inorganic matter to the amount of organic matter. Then Amalese can tell if a farmer has had problems with wind and water washing away his top soil. If erosion has taken place, her tests will not find much organic matter, which is needed for plants to grow well.

Amalese also tests soil to find out if the soil in one part of the state is different from the soil in other areas. She sometimes talks to farmers and ranchers about those maps and what they mean. She really enjoys giving those talks because her work in the laboratory does not give her much time to talk to many people. At the same time,

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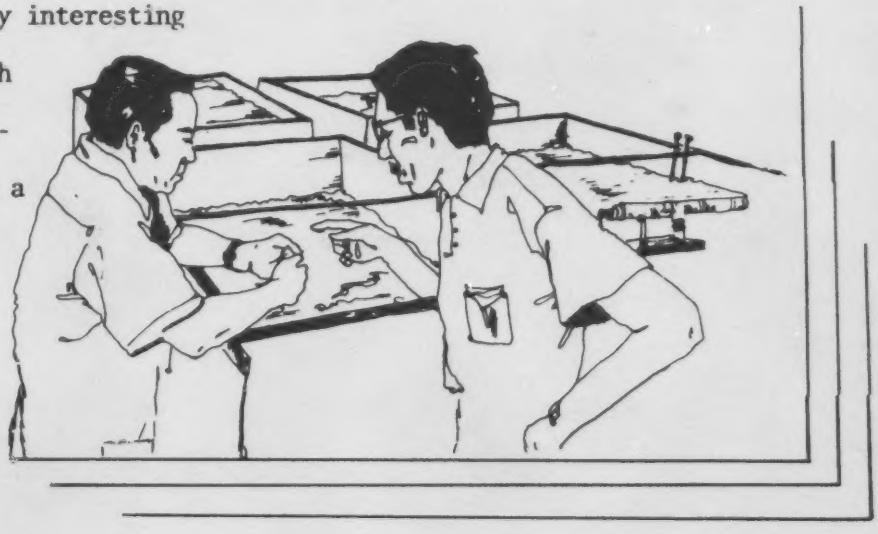
Amalese likes the thought that she is helping farmers and ranchers make more and better food for all of us.

County Extension Agent

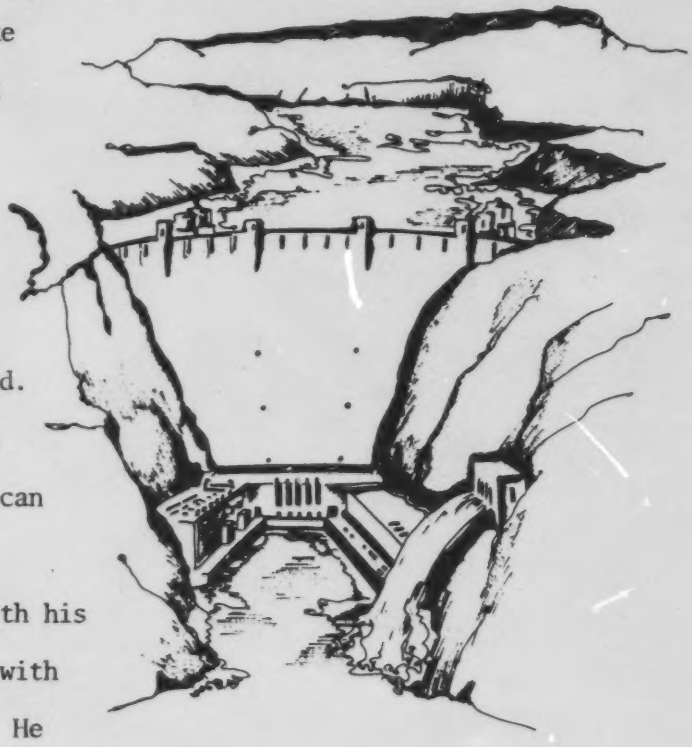
Pepe López is a very busy person. He has a nice office in the county building, but he is hardly ever in it except when he is talking on the phone. Pepe helps farmers solve many kinds of problems. Constant changes are going on all the time all over the earth. These changes mean that farmers have many problems to solve. If a farmer's crops aren't growing well, Pepe sends the soil to a soil scientist. If a river is always flooding the land, Pepe gets an agricultural engineer to build a dam to stop the floods. Problems with animals are also part of Pepe's job. He must know about research in animal health.

So you see, between seeing farmers about their problems and seeing experts about the solutions, Pepe is very busy. He doesn't mind, though. His job lets him meet many interesting people. It gives him both time outdoors and time indoors. It also gives him a chance to work with the natural things around him, such as animals and plants. Best of all, he likes knowing he has helped so many people.



Agricultural Engineer

Tom Long works with machines and builds things which help make natural processes work for man. When farms need more water than they are getting, Tom plans and builds irrigation ditches. Irrigation ditches bring water from rivers and streams to fields so that crops can have more water. Tom also builds dams to stop floods so that more land can be farmed. River valleys that often flood make good farms because the flood leaves behind good soil that has been washed from land further up the valley. As long as floods keep coming, no one can farm the land. When Tom finishes building a dam, the land below the dam can then be farmed.



Tom is quite pleased with his job because he gets to work with machines that build things. He likes the fact that he must spend some time inside planning his projects and some time outside making sure they are built right. When a dam is finished, Tom likes to stand at the bottom and look up at it. It makes him feel proud to know that he was the one who built such a grand project.

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Geologist

Sun Lui's job is to help find more oil and gas to run our cars and heat our homes. He does this job by studying rocks. When a rock

weathers from being in heat, cold, rain or wind, little bits break off. Different kinds of rock weather into different kinds of bits or fragments. These fragments then settle in layers on the earth and are covered by more layers of different kinds of fragments. When these layers are buried deep enough in the earth, the weight of what is on top pushes so hard that the bits become fused together as rock again. By taking samples from many layers of rocks Sun can tell what was happening a long time ago when oil and gas were beginning to form. Some kinds of layers mean that oil and gas may be near.

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Sun enjoys being outside in the fields and on mountains looking at rocks. Often he has to camp out at night because there are no towns nearby. Sun's job lets him go to many faraway places like Mexico and Alaska, too. Wherever there might be oil, Sun may get to go. Sun does not worry about losing his job because people will always need more gas and oil.

STUDENT WORKSHEET

Match the name of the person with the most likely job title. Read all the job descriptions carefully for clues.

Sun Lui	County Extension Agent
Amalese Washington	Geologist
Tom Long	Soil Scientist
Pepe López	Agricultural Engineer

Soil Scientist - Collects information about the soil through examination and records information on maps.

Agricultural Engineer - Designs and supervises construction of dams for flood prevention, spillways, irrigation terraces, and canals.

Geologist - Investigates structural formation of earth in order to locate oil and gas deposits.

County Extension Agent - Distributes information and instructions about improved methods of agriculture.

ANSWER KEY

Match the name of the person with the most likely job title. Read all the job descriptions carefully for clues.

Sun Lui	Geologist
Amalese Washington	Soil Scientist
Tom Long	Agricultural Engineer
Pepe López	County Extension Agent

Soil Scientist - Collects information about the soil through examination and records information on maps.

Agricultural Engineer - Designs and supervises construction of dams for flood prevention, spillways, irrigation terraces, and canals.

Geologist - Investigates structural formation of earth in order to locate oil and gas deposits.

County Extension Agent - Distributes information and instructions about improved methods of agriculture.

HOME and COMMUNITY

The student should talk with his family and their friends and neighbors to see if anyone has ever worked on a farm or in the oil industry. If someone has worked on a farm, the student should interview that person in order to find out how the soil was cared for, if there ever were problems with the soil, and what was done about those problems. If the student finds people who have or are working in the oil industry, he or she should ask them to describe their work and what they learned in school that helps them with their job.

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EVALUATION

Matching

I. Match the working conditions with the job title.

1. _____ Travels outside the state
2. _____ Works mostly alone
3. _____ Meets lots of people
4. _____ Travels a lot inside the county
5. _____ Works inside
6. _____ Does not have to worry about losing his job
7. _____ Goes on camping trips while doing his job
8. _____ Builds larger projects
9. _____ Works with large machines
10. _____ Works both outdoors and indoors

a. County Extension Agent
b. Geologist
c. Soil Scientist
d. Agricultural Engineer

II. Name two processes which affect the soil

1. _____
2. _____

EVALUATION

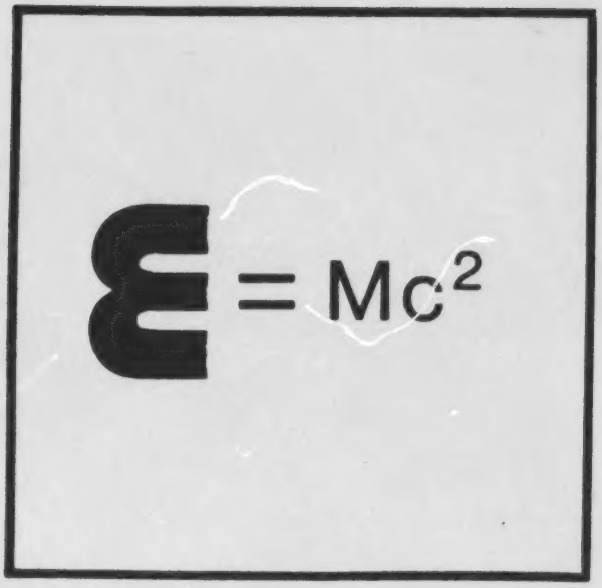
Answer Key

I.

1. b
2. c
3. a
4. a
5. c
6. b
7. b
8. d
9. d
10. a

II.

1. erosion
2. weathering



COMPONENT II
Section Two

Section Two
An Unfinished Story

Learning Objective

Given a narrative about the application of scientific knowledge of natural processes to a practical problem related to careers in Agribusiness and Natural Resources, the student will develop his or her own narrative in which the student character in the story supplies the answers to the problem, according to the criteria established by the teacher.

Key Words

- fertilizer
- cultivate
- county extension agent
- conservation
- organic matter
- inorganic matter
- weathering
- decomposition
- erosion
- terracing
- stripcropping
- contour farming
- wind break

Domains and Levels

Cognitive : Knowledge, Comprehension, Application, Synthesis

Affective : Receiving, Responding, Valuing, Organizing

Materials

- sufficient copies of the activity sheet
- sufficient paper for the completion of a story

IMPLEMENTATION GUIDELINES

Time: *45 Minutes*

STEP I - The teacher should read the introduction and briefly discuss the importance of conservation today.

STEP II - The teacher should present the narrative to the students.

STEP III - The teacher should lead a discussion about alternative endings to the story dependent on Ben's knowledge of science principles concerning conservation and the understanding of natural processes operating on the earth. Would it be possible for Ben to know everything that the soil conservationist told his father?

STEP IV - The worksheet may be completed individually or by the whole class working together.

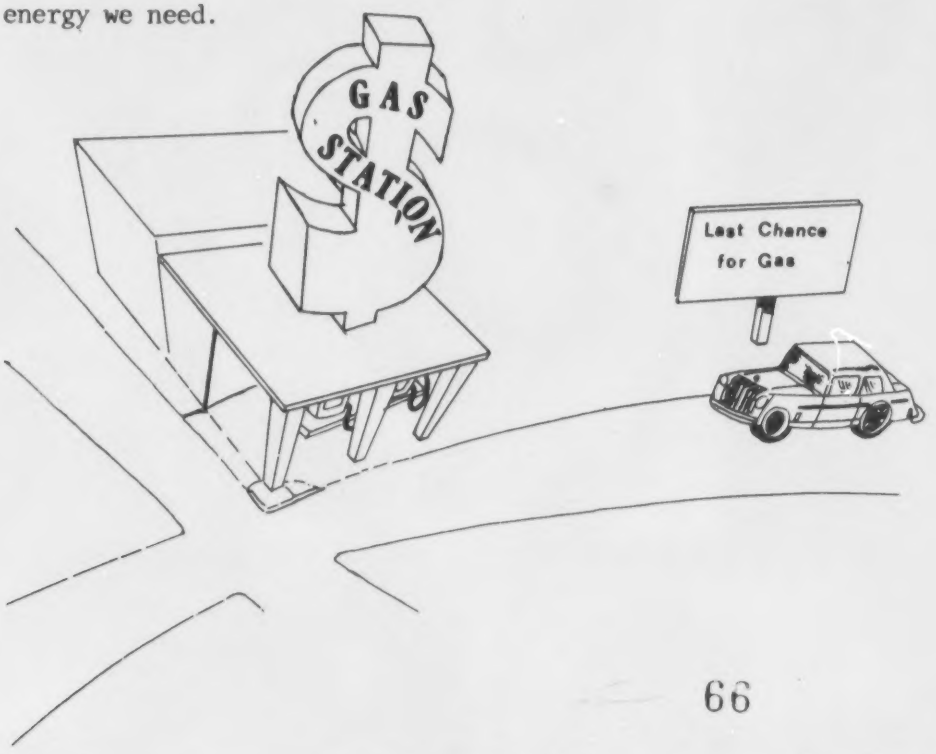
STEP V - The teacher should ask the students to write their own story given the fact that Ben had paid attention in school.

STEP VI - The Home and Community section is optional and can be completed if there is sufficient time.

STUDENT ACTIVITY MATERIAL

Introduction

Agricultural and natural resource workers have very important jobs. People can't live without food, and in order to live the way we are used to living, we need gas and oil to heat our houses and run our cars. In the past, Americans have thought that their natural resources such as good soil, lots of water and plenty of gas and oil, would last forever. Now we know that our gas and oil are almost gone, and our soil will not last unless we take care of it. Because more and more babies are being born and more and more people are coming to live in the United States from other countries, these jobs are now more important than ever before. When a great number of people need food and natural resources, the normal processes of change which make soil, oil and gas cannot keep up with man's needs. The environment is disturbed by man's presence. Workers in agriculture and natural resources help the earth keep giving us the food and energy we need.



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Changes

Ben Black was not very interested in school. His father was a farmer, and Ben knew he wanted to be a farmer, too. "What can I learn in school that my father can't teach me?" thought Ben. "I would rather be outside riding my horse."

Ben also liked to help his father plant seeds in the spring. In the fall he got to drive the tractor pulling a load of grain from the field to the storage bin near the barn. Ben liked the thought of being a farmer because he liked being outside and because even though he had to work hard in the summer, he had plenty of time in the winter to do as he pleased.

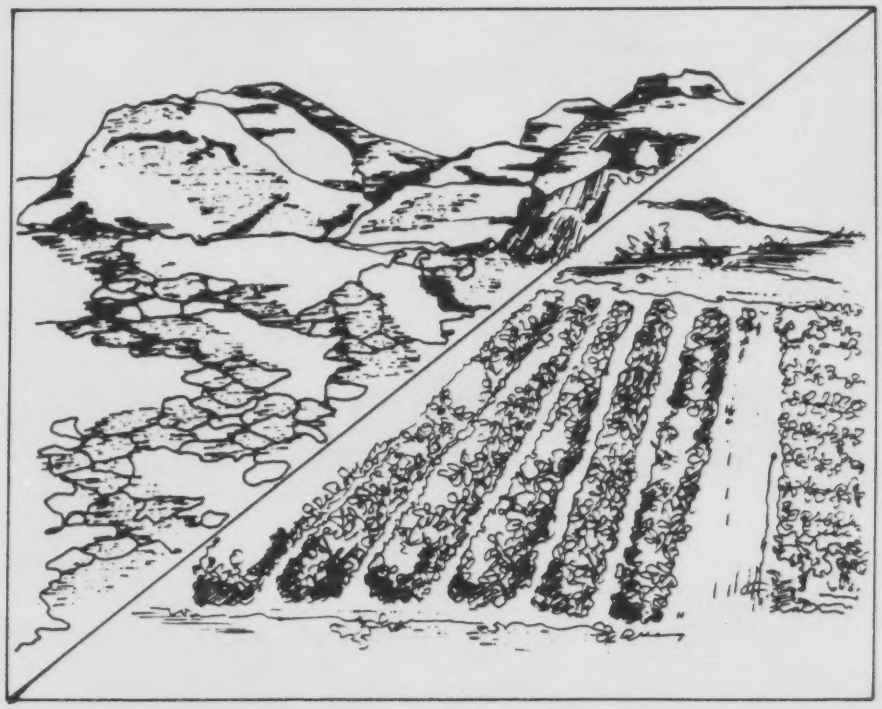
One summer after there had been much rain, Ben saw his father look more and more worried.

"What's wrong?" asked Ben.

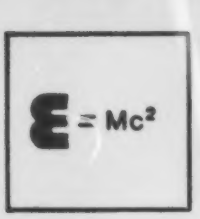
"I don't know. This year the crops are not growing well. They are not as tall or as strong as they should be. They don't seem to have bugs or to be sick. There must be something else wrong," said his father.

Ben's father's worried look grew and grew. He had worked very hard putting on plenty of fertilizer. He had also been careful to cultivate a number of times because he thought the weeds might be taking the food meant for the crops. But cultivating only made things worse.

Finally he called the county extension agent whose job is to find experts who can help farmers solve their problems. Ben's father and the extension agent talked over the problem and decided that the problem must be in the soil. The extension agent then sent a soil conservationist to inspect the soil. The soil conservationist helps farmers find ways to protect their soil. The conservationist carefully looked at the soil in the fields and also looked over each part of the whole farm.



"Mr. Black," he said, "your farm is on ground that has some small hills. Even those little hills are enough to cause the rain to wash away the top soil. When it is dry, the wind can blow the soil away, 73

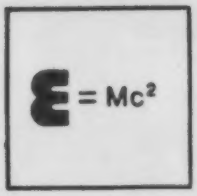


too. This process is called erosion. Since topsoil has lots of plant food in the form of organic matter, your crops are being starved. The subsoil that is left after the topsoil is eroded has only inorganic matter. You are lucky that you caught the problem now since you still have some topsoil left. Topsoil is made by a very slow process of weathering or breakdown of rocks and the decomposition of animal and plant forms. Building back topsoil that has been lost takes hundreds of years. You must stop the erosion process by terracing, stripcropping and contour farming and by planting rows of trees as windbreaks."

Ben thought he had heard the word "erosion" before. He went to his room and got his science book. Under the section on conservation, he found the word "erosion" as well as many of the other things the soil conservationist had talked about. He was very sad because he thought that maybe if he had paid more attention in school, he would have remembered these things. Then he could have explained the problem to his father before so much damage had been done.

In the years that followed, Ben noticed that the health of the crops improved a lot. He also saw that his father didn't have to work as hard fertilizing and cultivating as before. The bugs were fewer too, since bugs don't like healthy plants as well as sick ones.

Ben changed too. He started paying more attention in school.



WORKSHEET

Answer true or false in the space to the left.

_____ 1. Ben Black knew a lot about the conservation of natural resources.

_____ 2. Ben's father didn't know anything about farming.

_____ 3. A soil conservationist inspects and tests the soil to find out what problems there may be.

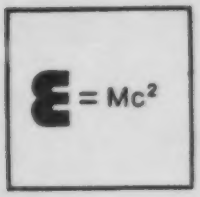
_____ 4. Erosion is a process that can ruin a farm.

_____ 5. Erosion can be helped by planting trees and stripcropping.

_____ 6. It only takes a few years to create topsoil.

_____ 7. Ben found out about conservation from his science book after the soil conservationist left.

_____ 8. When there is a problem with the soil, the county extension agent can help.



ANSWER KEY

Answer true or false in the space to the left.

F 1. Ben Black knew a lot about the conservation of natural resources.

F 2. Ben's father didn't know anything about farming.

T 3. A soil conservationist inspects and tests the soil to find out what problems there may be.

T 4. Erosion is a process that can ruin a farm.

T 5. Erosion can be helped by planting trees and stripcropping.

F 6. It only takes a few years to create topsoil.

T 7. Ben found out about conservation from his science book after the soil conservationist left.

T 8. When there is a problem with the soil, the county extension agent can help.

HOME and COMMUNITY

The student should ask his or her parents to help him experiment with a garden hose to evaluate the effect of running water on the environment. What happens if the hose is turned on bare soil on flat land, on hilly land? How strong does the flow of water have to be before erosion takes place? If the flow is very slow, does erosion still take place?

EVALUATION

Briefly, rewrite the story you have just read. In your story pretend that Ben had paid attention in school and could help his father. How would Ben's understanding of conservation and erosion have changed the story?

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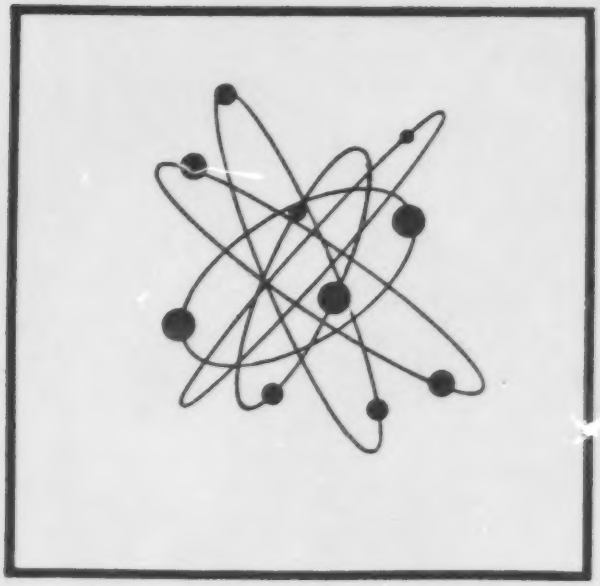
EVALUATION

Answer Key

Accept all logical answers, based on the narrative presented.



COMPONENT II
Section Three

Section Three
Working with the Earth

Learning Objective

Given a narrative concerning the scientific principles of soil composition and the natural process of soil building, the students will answer questions about the content of the selection with 70% accuracy.

Key Words

- decomposition
- organic material
- inorganic material
- weathering
- fragments
- silt
- erosion
- terraces
- compost
- humus

Domains and Levels

Cognitive: Knowledge, Comprehension, Analysis

Affective: Receiving, Responding

Materials

- sufficient copies of the student activity sheets
- evaluation

IMPLEMENTATION GUIDELINES

Time: *45 Minutes*

STEP I - The teacher should review some of the concepts involved in understanding the processes of decomposition, weathering and erosion.

STEP II - The students should read the narrative and complete the questions by themselves.

STEP III - The teacher should lead a discussion about the use of this kind of knowledge in other jobs and in other home situations. The last two questions on the evaluation can be used as discussion questions.

STEP IV - The Home and Community section is optional and can be completed if there is sufficient time.

STUDENT ACTIVITY MATERIAL

Working with the Earth

Marie Domínguez is a rancher who raises cattle. Marie must know about the natural processes of decomposition, weathering and the effect of wind and rain on the soil so that she can make sure the soil on her ranch will grow plenty of grass. Good grass is important for raising cattle.

In school Marie learned that wind and rain can erode topsoil. This would leave only the bare subsoil which doesn't have much organic material. Grass will not grow in soil that has only inorganic material. Soil is made from the decomposition of organic material such as plants and animals. Decomposed plants and animals form humus, the organic part of soil. Soil is also made from the weathering of rocks which forms sand, clay and silt. Rocks weather from heat, cold, wind and rain which cause the rock to break off in small bits or fragments. If the fragments that break off are large, they form sand. If the bits are very small, they form clay. And if there are both large fragments and small fragments, they form silt. Soil that has too much or too little of any of these things will have to have added what is missing if certain plants are to grow well.

CLAY

SILT

SAND

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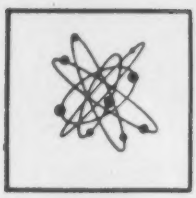

Marie has been lucky. The grass on her ranch is growing well and the cattle have plenty to eat. Marie has decided that the soil on her ranch must contain the right balance of everything. Since she wants to make sure the soil stays balanced and is not upset by erosion, she has planted trees to form windbreaks and to make sure the cattle change pastures before they eat up all the grass. Bare ground will always erode faster than ground covered with grass because it is open to wind and rain. In the fields where she grows corn and hay for the cattle, Marie plants her crops in strips, plows around hills instead of over them, rotates her crops, and makes terraces on steep hills to catch water. Marie also knows that the roots of some grasses hold soil better than the roots of other grasses. She makes sure her grass is the kind with the best roots.

Marie's range land is doing well, and so are her cattle. But Marie and her family are worried because their garden is not doing well at all. The plants in the garden are small and have many bugs. Some are sick, and none are giving many fruits or vegetables. Marie takes the soil from the garden to a soil scientist who tests it to see what's wrong. The soil scientist tells Marie that soil which is good for grass may not be good for growing vegetables. Marie's garden needs more organic material.

Marie decides to help her garden by making a compost heap. First she makes a wooden bin near her garden. Then she gathers all the dead leaves and dead grass from around the house and puts them in the bin.

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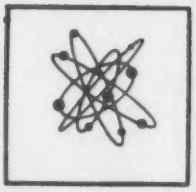
She adds fertilizer and plenty of water. Everyday she adds table scraps from the kitchen and more leaves and grass. Once a week she turns the heap with a pitchfork and adds more water. In a few months the whole heap is decomposed and ready to spread on her garden.

Now Marie's ranch is really doing well. Her cattle are fat and sleek, and now that her garden is giving lots of fresh fruits and vegetables, Marie's family is happy and well too.



Worksheet

Complete the following:

1. The natural process that affects organic material is called _____.

2. The natural process that affects inorganic material is called _____.

3. Two weather elements that can cause erosion are _____ and _____.

4. Sand is made from _____.

5. Bare ground without grass will erode _____ than ground with grass.

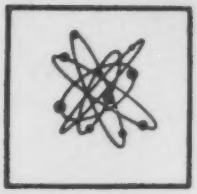
6. A compost heap can be made from _____, _____, and _____.

7. Soil may be good for growing grass but not for _____.

8. One way to prevent erosion is to _____

_____

_____



Worksheet Answers

Complete the following:

1. The natural process that affects organic material is called decomposition.

2. The natural process that affects inorganic material is called weathering.

3. Two weather elements that can cause erosion are wind and rain.

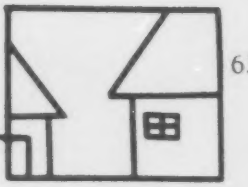
4. Sand is made from rock's large fragments.

5. Bare ground without grass will erode faster than ground with grass.

6. A compost heap can be made from water, fertilizer, and dead leaves and grass.

7. Soil may be good for growing grass but not for vegetables.

8. One way to prevent erosion is to plant trees to form windbreaks and make sure that the cattle change pastures before they eat up all the grass.



HOME and COMMUNITY

The student should ask his or her parents to help him find samples of sandy, silty and clay soil. Once the sample is found, the student should explain to his or her parents the process which produced the sample and why one sample is different from the others.

EVALUATION

1. What natural process works on organic material?

   _____

   What is the result of this process?

   _____

2. What natural process works on inorganic material?

   _____

   What are the three types of soil that result from this process?

   1 _____

   2 _____

   3 _____

3. How are these three types of soil different from each other?

   _____

   _____

   _____

4. What are some of the ways, erosion can be stopped?

   1 _____ 4 _____

   2 _____ 5 _____

   3 _____ 6 _____

5. What are some of the natural forces which cause rocks to weather?

   1 _____ 3 _____

   2 _____ 4 _____

EVALUATION

Discussion:

6. What would happen if Marie did not know that she should not let her cattle eat all the grass down to the bare soil?

_____

_____

_____

_____

7. If you wanted to plant a garden and the soil was mostly clay, what would you have to do to get plants to grow well?

_____

_____

_____

_____

EVALUATION

Completion Answers

1. What natural process works on organic material? decomposition

   What is the result of this process? humus

2. What natural process works on inorganic material? weathering

   What are the three types of soil that result from this process?

   1. sand 2. silt 3. clay

3. How are those three types of soil different from each other?

   Sand is made from large fragments

   Clay is made from small fragments

   Silt is made from both large & small fragments

4. What are some of the ways erosion can be stopped?

   1. stripcropping
   2. terracing
   3. crop rotation
   4. Contour plowing
   5. planting windbreaks
   6. avoiding bare ground

5. What are some of the natural forces which cause rocks to weather?

   1. sun or heat
   2. wind
   3. cold
   4. rain

EVALUATION

Discussion:

6. What would happen if Marie did not know that she should not let her cattle eat all the grass down to the bare soil?

Accept all logical answers.

7. If you wanted to plant a garden and the soil was mostly clay, what would you have to do to get plants to grow well?

Accept all logical answers.

Component 3

Section One

Section Two

Section Three

IMPROVING OUR ENVIRONMENT

OVERVIEW

The activities in this component will help the student understand which are the professions related to the environment. Also, the student will be able to understand the relationship between scientific knowledge and those careers.

The environmental careers directly related to the land are presented in Section One. Section Two deals with air pollution and forecasting its consequences. The third section includes environmental professions dealing with water. The student will learn about water pollution through data interpretation.

GOALS

COMMUNICATING:	The student will relate to the need for communication in transferring skills between professional and non-professionals in environmental careers.
PREDICTING:	The student will predict possible outcomes of individual decisions based on environment and value systems.
INTERPRETING DATA:	The student will examine data in a given situation and interpret the data for environmental impact.

LEARNING SECTIONS

Section 1: *Farming Near the City*

Section 2: *What Do You Think?*

Section 3: *Water and Air Pollution*

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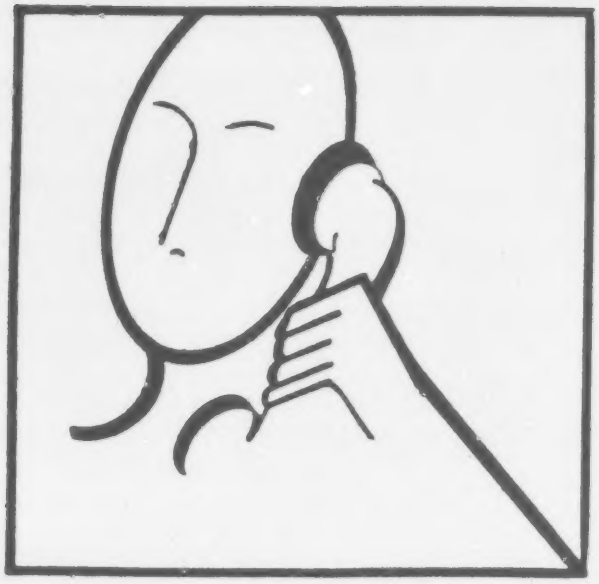


COMPONENT III

Section One

Section One
Farming Near the City

Learning Objective

Given a narrative that describes environmental impact in an agricultural setting near an urban area, the student will relate communication skills and the need for the transfer of skills among professionals and individuals with 70% correct answers.

Key Words

- environment
- smog
- irrigation
- insecticide
- biochemist
- soil
- conservationist
- meteorologist
- communication
- pollution

Domains and Levels

Cognitive : Knowledge, Comprehension, Application

Affective : Receiving, Responding

Materials

- activity sheets
- evaluation sheets

IMPLEMENTATION GUIDELINES

Time: *45 Minutes*

STEP I - The teacher should introduce the student activity with a short discussion of man's impact on the land, water, and air. The discussion should include information that lists how people may improve the quality of the environment.

STEP II - The students should read the narrative either silently or take turns reading orally, depending on the reading level of the group.

STEP III - The teacher should lead a discussion that is based on questions that are in the narrative or that arise from the students' reading. The following questions may be helpful in furthering the discussion:

1. Why is communication among specialists and individual users of information important?

   Example: The information from a meteorologist used by a farmer.

2. What are some activities that farmers and city dwellers do that affect each other and the environment?

STEP IV - The students should complete the activity sheet either individually and share their answers with the class or work in teams and the teams share their answers with the other teams.

STEP V - The students should complete the role playing activity and its related questions. Students should be paired in a manner to decrease the chance of similar interests. Boy/Girl teams may have different interests. Student observations may be shared with the class.

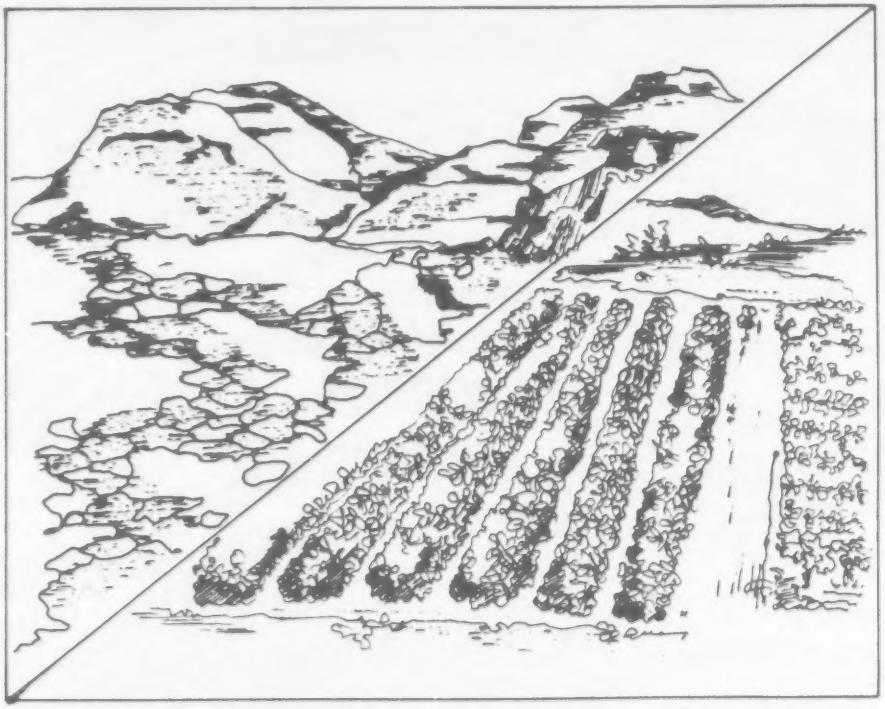
STEP VI - Each student should complete the individual evaluation.

STEP VII - The student may be assigned the Home and Community section as homework or extra credit, depending on the amount of time available.

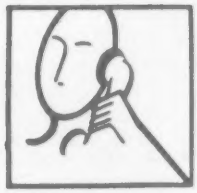
STUDENT ACTIVITY MATERIAL

Farming near the City

The large city with all of its tall buildings, freeways, factories, and people is only ten miles from Ed Perch's small farm. Mr. Perch is a truck farmer. Truck farmers raise vegetables and fruits that they harvest and sell at markets in the city. Ed makes all of his yearly income from the crops he sells during the summer months.



The weather plays a big role in how much money Ed makes each year. Some years there is too little rain, and crops wither in the sun. The soil is blown away by dry winds. Other years there is too much rain, and the vegetables and fruits mildew and rot because of standing water. When the



water runs off after the rain, it washes the soil into streams on the farm. In the early spring, when the small young plants are just coming out of the ground the weather may turn suddenly cold, and a frost may kill many of them.

The weather is not the only thing that affects Mr. Perch's crops. Each year, insects destroy many plants and vegetables taking money from Ed's pocket. In the last ten years, the yield from his farm has been declining. The fruit trees have been producing less. Some of the leaves have been turning brown. Some trees have died, and many of the peaches and pears have blemishes. Ed knew he had problems with his production. He knew some of the reasons that caused his crops to fail. He did not know all of the reasons or what he could do.

Ed was puzzled, to say the least. He just did not know what to do about his crops. One morning he loaded his pick-up truck with that day's harvest and drove to the farmer's market in the city. As he drove toward the city the traffic began to increase. Thousands of people were going to work. Ed was looking at the skyline as he drove and noticed a brown haze hanging over the city like fog. He thought that it was nice to live in the country and not be bothered by the brown fog. As usual, he arrived at the market in time to set up in his same spot. Ed thought that this day was going to be the same as in the past, but today was going to be different.

Around ten o'clock several people with films, pamphlets and public address system came to the market. These people were from the County Agricultural Extension Office. Mel March had been the son of a truck farmer. He was the county agent. Mel had decided to bring specialists to the farmers

in the market to help them understand the problems they were having with their crops.

Mr. March was a specialist. As the county agent he knew the problems that affected the local farmers, problems such as weather, insects, soil conditions, water, and pollution. He brought with him several other specialists. Cleah Garret was a biochemist. She understood the effects of the environment on growing plants. She knew that the brown fog over the city was smog caused by car exhaust and factories. The smog could cause brown spots on leaves, kill plants and damage fruits on trees. Rusty McGrit was a soil conservationist. He knew that water washed away good top soil and that the lack of water would allow the wind to blow the dry top soil away. He knew the proper drainage and irrigation of the land was important.

The third specialist was a meteorologist, better known as a weather forecaster. He was known to Ed because he listened to him on the local

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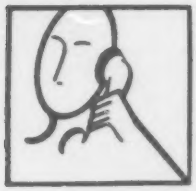

radio station. Jacque Frost had been reporting the weather conditions for years and knew the importance of the weather to the farmer. He came to the market to help the farmers understand what caused the weather to change.

Ed watched as Mel's group set up the equipment they had brought. He really did not understand why these people were in the market. While Mr. March's people were setting-up the films, chairs, tables and public address system, he and the specialist walked around the market and talked with the farmers. Mel approached Ed.

Mel: Hi! I'm Mel March, your county agricultural extension agent.

Ed: Ed Perch is my name. What are you boys doing with all that equipment?

Mel: Well Ed, we came here to try and help you raise better crops. Are you having any problems this year?

Ed: Mel, you would not believe the problems I'm having!

Ed went on to tell the agent about the weather, decreasing yields, insects, and the brown spots on his fruit.

Mel: You do have some problems. I think you need to talk with the people that came with me. They are specialists in the problems you are having on the farm.

Ed: I've listened to what some of them have been saying, but I do not really understand many of those fancy words.

Mel: Why don't you see the films about "Insect Control," "Weather & the Soil," and "Pollution and Plants." Maybe that will help you

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understand what we are trying to say.

Ed saw the films during the day and began to understand what the specialists were saying. He read all of the pamphlets and talked with each specialist. He found that he could use the knowledge he had learned from the meteorologist, biochemist and soil conservationist. Ed learned that pollution had ruined some of his crops. Insecticides poison the insects and the fish in the stream on his farm. He found that the soil on his farm needed a special type of fertilizer. Water canals could be used to drain his fields when there was too much rain and water his fields when there was not enough rain.

At the end of the day, Ed went over to Mel and the others to thank them for their help. He loaded his truck and drove home. He felt satisfied that he had gained new understanding by communicating with the agent and the specialists. Next year the crops would be better, his income will increase and many of his problems would be solved.

Role Playing Activity

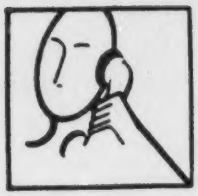
The need to communicate a skill or information is important to each of us in our daily lives. Each of us knows something special that others around us may not know.

In this activity, you will be a specialist. You may be a specialist in anything you know a lot about, such as how to make a cake, how to turn a car or how to play cards. You choose your own speciality. Now what you have to do is communicate information about your speciality to someone in the class so that they will understand how to do your speciality. Here is what you have to do:

1) Choose your speciality.
2) Find a partner or take the partner assigned by your teacher
   One of you will be the specialist the other will be the information user. You will switch roles after the first specialist is through.
3) Each of you will need a name tag.

Specialist	Information User

4) The specialists will communicate their information to the information user. The information user must understand everything and be able to do what the specialist can do.
5) Switch roles when you finish; be sure to exchange your name tags. Complete step four again.



Student Worksheet 1

1. What are some of the reasons that Ed Perch's crops are not as good today as they were ten years ago? _____

_____

2. Why are the skills and knowledge of the specialists important to Ed Perch? _____

_____

3. What are some of the means that these specialists are going to use to help the farmers understand their problems and how to solve the problems? _____

_____

4. List any other specialist you know of that may help the farmers and explain how they help. _____

_____

5. List the ways specialists can communicate their skills to others.

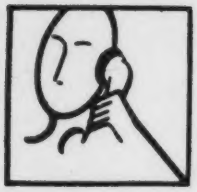
_____

_____

6. What are some ways that the quality of the land, water and air may be improved by farmers, people in the city and specialists?

_____

_____



Answers

1. Weather changes, such as too much or not enough rain; loss of top soil by the action of wind and water; insects that destroy crops; decreasing crop production; mysterious destruction of fruit and fruit trees.

2. Mr. Perch has problems with no known solution. The specialists may have solutions that will solve those problems and identify other problems of which he may not be aware. Accept any logical answer.

3. Talking about problems, showing films about those problems, handing out pamphlets about problems. Accept any logical answer.

4. Soil scientist, to understand soil problems; agricultural teacher, in school to explain ideas or concepts to solve problems; agronomist, to understand crop choices for the type of soil. Accept any logical answer.

5. Talking, films, pamphlets, speeches, demonstrations, explaining terminology. Accept any logical answer.

6. Reduce car exhaust and factory fumes.

   Less use of harmful insecticides

   Use of irrigation techniques to prevent soil loss

   Understand the problems and their solutions

   Communicate

   Accept all logical answers

Student Worksheet 2

1. a) Was it easy or hard to explain your speciality?

_____

b) Why do you think so?

_____

c) How could you improve your explanation to the Information User?

_____

2. a) What kind(s) of communication skill(s) did you use to explain your speciality?

_____

_____

b) Would some other way have been better?

_____

3. a) As the Information User, did you understand everything the specialist gave you?

_____

_____

b) What kind(s) of communication skill would have made you understand better?

_____

_____

_____

Answers

1. a) Answer will vary

   b) Answer will vary

   c) Use models, show film, actually do the speciality, draw pictures, any logical answer.

2. a) Talk, use hands, draw pictures, define words, write on paper, any logical answer.

   b) Answer will vary

3. a) Answers will vary

   b) Models, pictures, films, any logical answers

HOME and COMMUNITY

The students may talk with family members or friends about the impact of the city or land, water, and air quality. The student may ask about the quality of environment in the past as compared with the present.

Local community resources abound in information about environmental impact. The County Agricultural Extension Office may be able to arrange a field trip to a local farm or supply a speaker for the class. You may wish to contact the local colleges and universities on the Environmental Protection Agency for any additional resources for the classroom.

EVALUATION

1. List two specialists that deal with the use of land, water or air.

   1. _____

   2. _____

2. How can an urban environment affect farming nearby?

   _____

   _____

3. How does farming affect the land and water?

   _____

   _____

4. List four types of communication methods on skills.

   1. _____ 2. _____

   3. _____ 4. _____

5. How can communication between specialists and users of information be improved?

   _____

   _____

   _____

EVALUATION

Answers

1. Meteorologist, biochemist, soil conservationist, farmer, agricultural agent. Accept all logical answers.

2. Cities create pollution which may ruin crops.

3. Insecticides, fertilizer, and soils are washed in rivers by rain which may affect animal life.

4. Talking, writing, films, pamphlets, pictures, models. Accept all logical answers.

5. Open lines of communication, understandable terminology, use of films, or any logical answers.

COMPONENT III
Section Two

Section Two
What Do You Think?

Learning Objective

Given an activity and a short narrative, the student will be able to predict in a logical manner the effects on environment that stem from factors such as individual incomes, culture, value system and careers, according to the teacher's criteria.

Key Words

- environment
- engineer
- pollution
- erode
- recreation
- value

Domains and Levels

Cognitive: Knowledge, Comprehension, Application, Analysis, Synthesis

Affective: Receiving, Responding, Valuing

Materials

- student activity sheets
- evaluation

IMPLEMENTATION GUIDELINES

Time: *45 Minutes*

STEP I - The activity "What do you think?" should be implemented at the start of class. An explanation of the words in the list may be necessary. A class poll may be taken to determine class response. Students should answer all other questions individually.

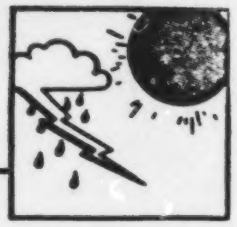
STEP II - The teacher should lead a short discussion about the nature of individual values and how values affect individual perspectives concerning the environment. The student should relate individual value systems to the ability to predict outcomes of value-based conflicts concerning the environment.

STEP III - The students should read the short narrative, "Environment or Copper," either silently or orally/ The questions should be answered individually followed by class discussion or in small groups to reveal differing value systems among peers.

STEP IV - The teacher should attempt to explain through discussion the problems of predictcing outcomes of value-based conflicts and the variables inherent in this situation.

STEP V - Each student should complete the evaluation. Students should be encouraged to write complete statements in a short paragraph format.

STEP VI - The Home and Community section is optional.



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STUDENT ACTIVITY MATERIAL

What Do You Think?

Each of us has different living conditions. Some people make more money than others, and we live in different homes with different parents.

You may enjoy baseball and the person across the room may like volleyball. Each of us believes in different ideas. This is good because it makes our lives interesting.

Let's see what interests you the most. Below is a list of words or ideas. Read the list and order it from the most important to least important. As you make your list think of the reason why you made this choice. There is no right or wrong order; it's just up to you.

List	Your List
1. Environment	1.
2. Family	2.
3. Friends	3.
4. Health	4.
5. Home	5.
6. Job	6.
7. Money	7.
8. Recreation	8.
9. School	9.

After you finish your list, the class needs to answer the following questions and fill in the table shown below with the number of people.

1) How many people place the word environment first on the list?

_____

2) How many people place the word environment last on the list?

_____

3) How many place the word environment in the first five words?

_____

4) How many place the word environment in the last four words?

Place in list	Number of People
First	
Last	
First Five	
Last Five	

_____

5) Where did you place the word environment in the list? What was your reason?

_____

6) Do you think that all of the other words in the list really depend on the quality of the environment? Why or Why not?

_____

What Do You Think?

Answers

1) Class poll

2) Class poll

3) Class poll

4) Class poll

5) Accept any logical answer.

6) Accept any logical answer.

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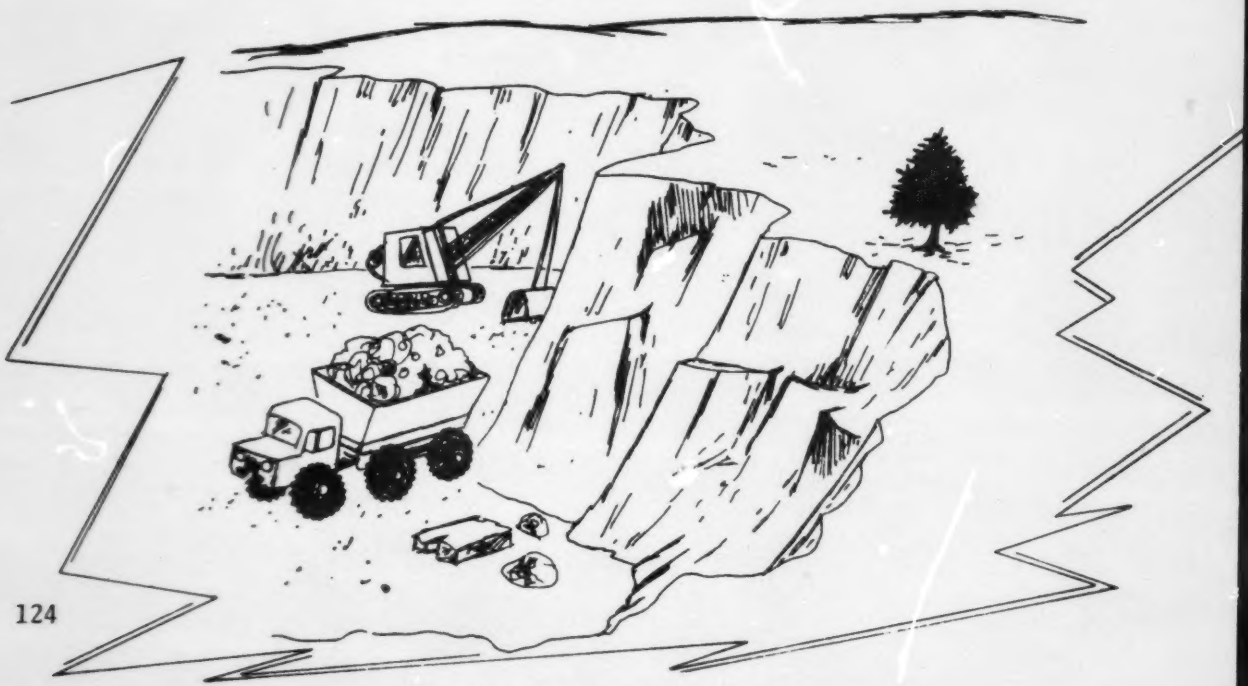
Environment Versus Copper

Deer Lodge National Forest is a beautiful preserve for wild life and forests of tall evergreen trees. Neal Feather has been a park ranger here for about ten years. His job lets him enjoy the outdoors. He enforces the rules of the park and makes sure the park is kept from harm such as fines and theft. Recently, the news arrived that a new supply of copper ore had been discovered by geologists that had surveyed the area. Neal loves the forest and he knows what this could mean to the wildlife, forests, and rivers in the area.

Global Copper Mining, Inc. had bought the rights to mine the new ore. Global's mining engineer, Eli Grovic, was sent out to find out about the type of mining that was to be used at the new site. He had decided that the cheapest way to mine the ore was open-pit mining and that the ore should



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be processed near the mine. In a new smelter, many thousands of gallons of water will be used in the smelter. The source of water will be the Clark Fork River that moves through the National Forest.

Neal Feather was upset about the new copper mine. He was concerned about the destruction of the forests and pollution of the river. Many

of the people who lived in the area were either for the new mine or against it. A meeting was held by the State Health Board to listen to the reasons for or against the new copper operation. In the meeting many people had the opportunity to discuss their ideas about the new mine. This is a summary of what the people and the representatives of global mining had to say:

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Global Copper Mining, Inc.

Eli Grovic, Global's mining engineer presented this information to the board:

"The United States now produces one and a half millions tons of copper per year, but we have to import much more from other countries to meet our needs. This mine and smelter will cost 50 million dollars to build, but without this operation the nation may lose up to 200 million dollars per year to other countries in buying their copper. Global is concerned about the environment. The mine and smelter will produce very little pollution to the forest, wildlife, and rivers in the area. The mine will be located in an area where very few people live.

Global will have to pay 10 million dollars a year in taxes and this means better schools, roads, and services to the people in the area. The operation will create 500 new jobs for the people in the area and improve their standard of living."

Citizens Against the Mine

Neal Feather represents the local citizens that opposes the mine. He presented this information to the board:

"Have any of you ever seen an open pit mine? They are huge. Often they are 5 miles across and a mile deep. This will cause much of the land to be ruined and many thousands of acres of trees will be destroyed. These forests are slowly being destroyed; soon just a few forests will be left. The pit mining operation will cause the land to erode and this will

cause Clark Fork River to become filled with the run-off. This will kill the fish and ruin the river, a source of recreation for thousands of people who come here each year on vacation. The smelter, used to process the copper ore, uses acids and chemicals which will kill the wildlife in the river. The smoke from the furnaces will pollute the air and make the area unfit to live in."

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Citizens for the Mine

Jan Mandrell has lived in the area for 40 years with her family. This is what she told the board:

" My friends and family have lived here for many years. The area is poor and tourism is our only income. We make our money only during the tourist season. This mine will allow us to buy new homes and offer us security for many years ahead. We realize that the land will be destroyed a little and there will be some water and air pollution, but the mining company said that they will reduce this as much as possible. We need the mine if we are to have better lives."

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Friends of the Earth

"Friend of the Earth" is a national environmentalist group. Niece George represented them to the board and this is what one member had to say:

"People across the country look to Deer Lodge National Forest and the Clark Fork River as one of the last places left of real wilderness and natural surroundings. The people in the area make moderate incomes from guided tours and the tourists. We have all grown up wanting this and that to improve our lives. But does increased wealth really improve our lives? The people here live in harmony with nature. The mine will destroy this harmony."

Worksheet

1. If you were on the health board what would you do? Can you predict the outcome? Remember, the United States needs the copper and the mine will help the people in the area. But the mine will also ruin some of the environment and probably reduce tourism in the area.

_____

_____

_____

2. Is there any way to have the copper mine and protect the environment? Use your imagination. _____

_____

_____

3. Do the way people feel play a role in this story? How? Give examples of the feeling in the story.

_____

_____

_____

4. Do the people in the story value the same things? Give examples.

_____

_____

_____

5. Does the way people live affect their ideas? Give an example.

_____

6. Neal Feather is a native American Indian; do you think his culture may

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affect the way he feels about the mine? How?

Environment Versus Copper

Answers

1. Many answers are possible. The following are a few solutions:
   a. The mine will not open.
   b. The mine will open as planned.
   c. The mine will open as planned but with restrictions on pollution.
   d. A different type of mining operation but this will cost more money.
   e. Move the smelter to another location.

2. Many solutions are possible. The following are a few solutions:
   a. Pollution restrictions
   b. Reclaim the land and plant new forests after mining.
   c. Treat the water being dumped into the river.
   d. Different type of mining operation.
   e. Move the smelter to another location.

3. Feelings do play a role by causing people to take action and defend their ideas. Neal Feather loved the forest and wildlife enough to try and protect them. Jan Mandrell was concerned about her family and friends' need for security.

4. The people in the story have different values. Eli Grovic had the interest of his company and the nation's need for copper in mind. Niece George was concerned about having more economic goods. Any logical comparisons are acceptable.

5. The way people live does affect their ideas. Jan Mandrell was from low income group seeking to improve her life. Other answers are possible.

6. Neal's culture may affect the way he thinks. American Indians have historically had a close association with the environment. (This may be stereotyping; be careful with this idea).

HOME and COMMUNITY

The students may talk with family members about how they feel about the environment. These questions may be asked:

1. Does your job affect the environment? If so, how?
2. If you had a chance to protect the environment on the job would you do so? Why or why not?
3. Do you believe the environment should be protected for the future?
4. Protecting the environment is expensive. Would you be willing to pay more for the things you buy if some of the money would go to the protection of the environment? Why or why not?

EVALUATION

1. How does income affect the way people feel about the environment?

2. Can you predict how a person's job will affect the way he or she feels about the environment?

3. Does the way a person values the environment affect the type or kind of job that person will do?

4. What are values and what do they depend on?

5. If the copper mine begins operations without any pollution control, predict what will happen to the environment.

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EVALUATION

Answers

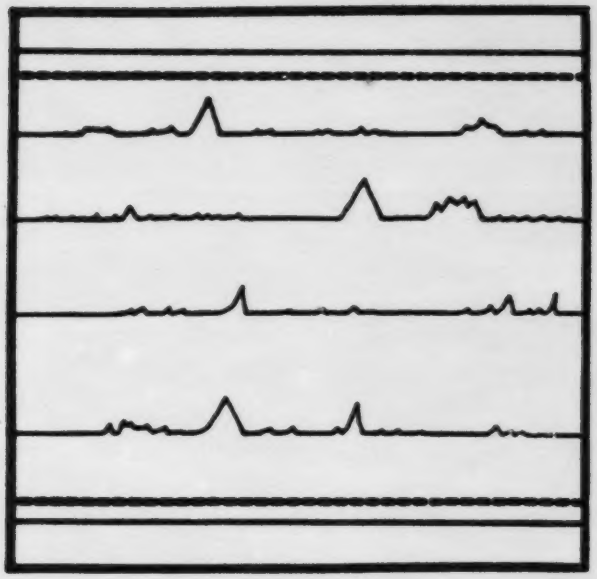
1. The income of a person may affect the decisions that he/she has to make. If you are hungry, then the environment may have to wait. But if you are comfortable, the environment may be important. Any logical answer is acceptable.

2. A person's job is based usually on that person's interests. If security is an important value then the environment may be a secondary value. Any logical answer is acceptable.

3. If a person values the environment it will affect his/her job selection. And the converse is also true.

4. How a person feels about something is a value. Values are affected by income, culture, and profession or job.

5. The land will be ruined by open pit mining, forests will be destroyed, and the rivers will be polluted with run-offs and chemicals. Accept all logical answers.



COMPONENT III
Section Three

Section Three
Water and Air Pollution

Learning Objective

Given two short narratives with an associated experiment, the student will understand the impact of pollution caused by man on the environment and interpret collected data associated with each experiment with 80% accuracy.

Key Words

- food chain
- environment
- biologist
- population
- graph
- pathologist
- variables
- control

Domains and Levels

Cognitive: Knowledge, Comprehension, Application, Analysis

Affective: Receiving, Responding

Materials

- copies of activities
- copies of enrichment activity
- evaluation

IMPLEMENTATION GUIDELINES

Time: *45 Minutes*

STEP I - The teacher should briefly discuss with the class the nature of experimentation and the need to control variables. The discussion should mention the use of a control as a means of comparison.

STEP II - Each activity may be worked individually or in small groups. The activities may be read silently or orally.

STEP III - After each student has had sufficient time to answer the questions at the end of each activity, the questions may be discussed orally.

STEP IV - If the student(s) wish to pursue the experiments done in the activities as enrichment, a list of materials and procedures are found in the Enrichment Experiment for water Pollution and Air Pollution.

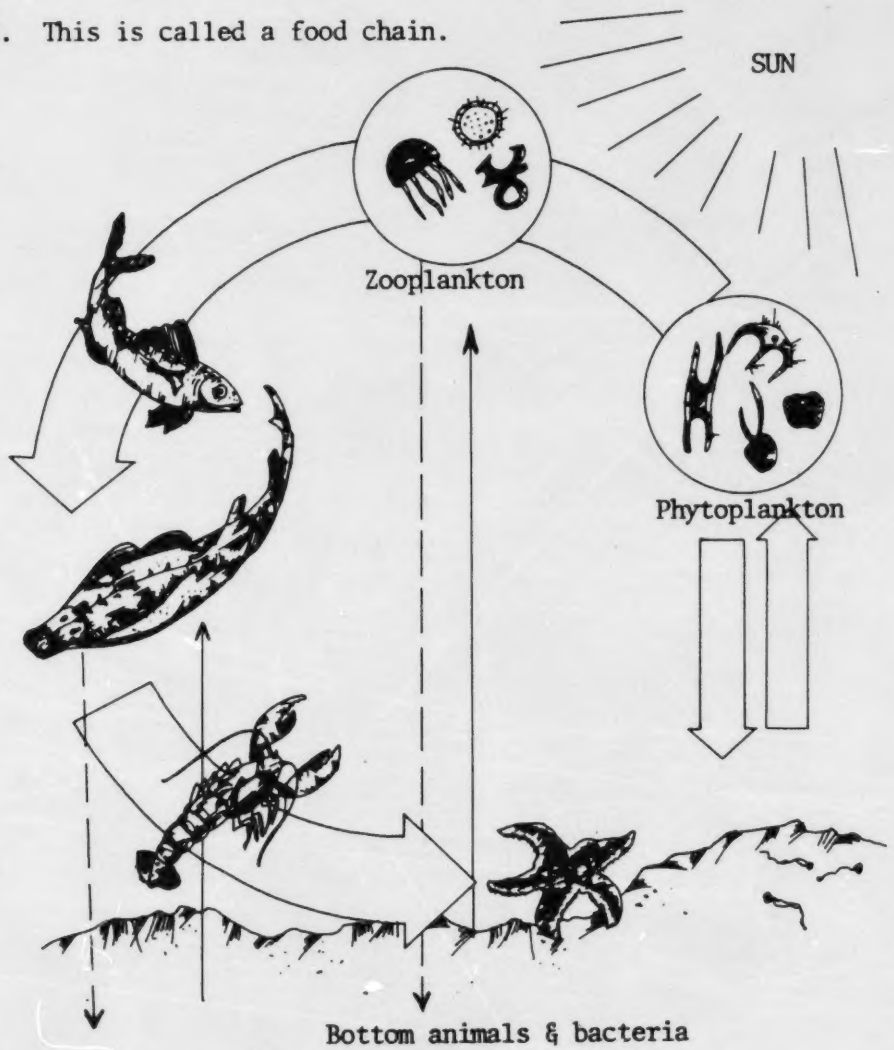
STEP V - Each student should complete the evaluation.

STEP VI - Home and Community is optional.

STUDENT ACTIVITY MATERIAL

Water Pollution

Tomás Couto is a fishery biologist. He sudies the history, habits, classification, and economic relationship of animals that live in the water. He sometimes does experiments that will explain how water creatures are affected by man's changing the environment. Tomás is interested in this because water creatures are food for fish. Fish is a source of food for people around the world. This is called a food chain.



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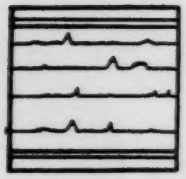
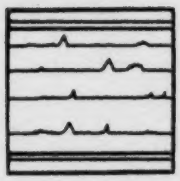


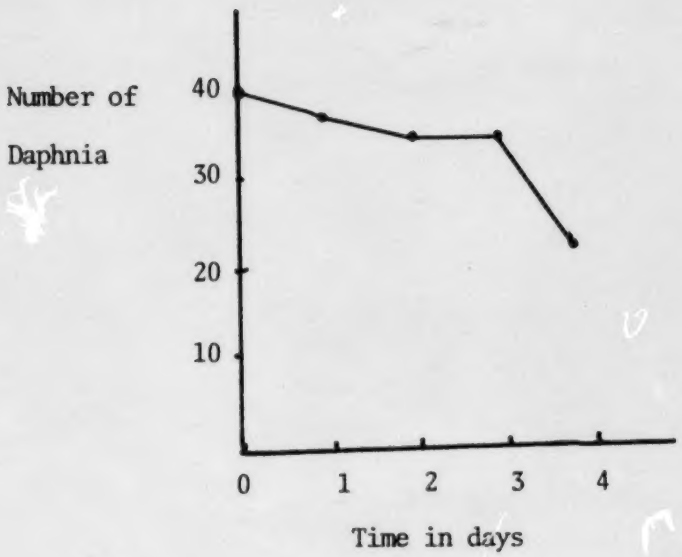
Mr. Couto has been concerned about how an oil spill will affect the food chain for fish. If there is less food for fish, then many fish will die, and there will be less food for people. One source of food for fish is the water flea or Daphnia. They are very small and live in fresh water. Tomas would like to know if an oil spill will affect the number of Daphnia in a given population.

To find out, he set up an experiment. The control variable in the experiment had to be the oil. A variable is anything that may change the results of an experiment. All other variables such as the number of Daphnia, amount of water, food and temperature had to be the same all the way through his experiment. If Tomás did not control these variables he could not tell if the oil affected the Daphnia or if something else did.

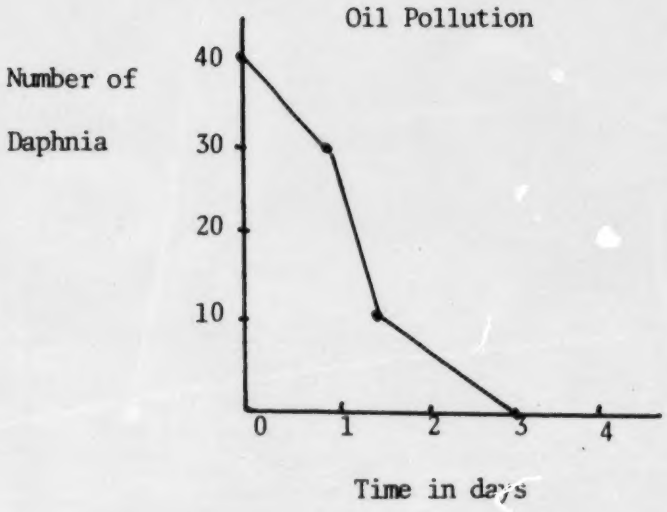
Tomás placed the same number of Daphnia in the same amount of water and fed the Daphnia the same food for four days. The only difference was that one of the jars had some oil poured into the water. The oil was like an oil spill. He then counted the number of Daphnia that were alive each day for four days. At the end of four days he made a graph of the results of his experiment so he could see what had happened to the Daphnia population.



No Oil

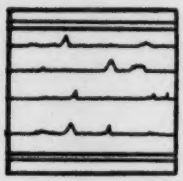


Oil Pollution



These graphs show what happened to the number of Daphnia in each jar.

Answer the following questions about Tomás's experiment and data. 143



1. Was the number of Daphnia the same in each jar at the end of your experiment? Why did this happen?

2. Which population of Daphnia decreased the fastest? Why did this happen?

3. From the experiment can you say that an oil spill will affect the food chain? Why or Why not?

4. How does an oil spill in the ocean affect our environment?

5. Does making a graph with data help you understand the data better? Why or why not?

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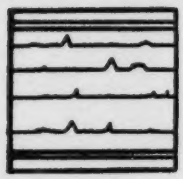
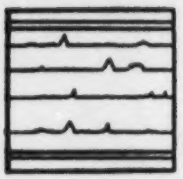


6. What does a fishery biologist do?



Answers

1. The number of Daphnia are different at the end of the experiment. The reason for this may be the oil, lack of food and lack of oxygen. Accept any logical answers.

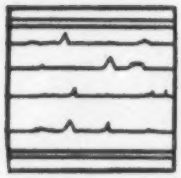
2. The Daphnia with oil died at a faster rate due to the oil and lack of oxygen. Accept any logical answer.

3. Answer may vary. The reasons are more important. Accept any logical answer.

4. Oil spills affect the food chain by killing creatures used for food. They also affect beaches and recreation. Accept all logical answers.

5. Answers may vary. Graphing should help because one can see more clearly the relationship of data.

6. Fishery biologists study the history, habits, classification, and economic relationship of animals that live in the water. They try to understand the impact of environmental change on water creatures.



Water Pollution

This is an optional activity. You may do this experiment and collect your own data just as Tomás did. You will need the following materials and about three or four days!

Material:

A - 2 clean battery jars

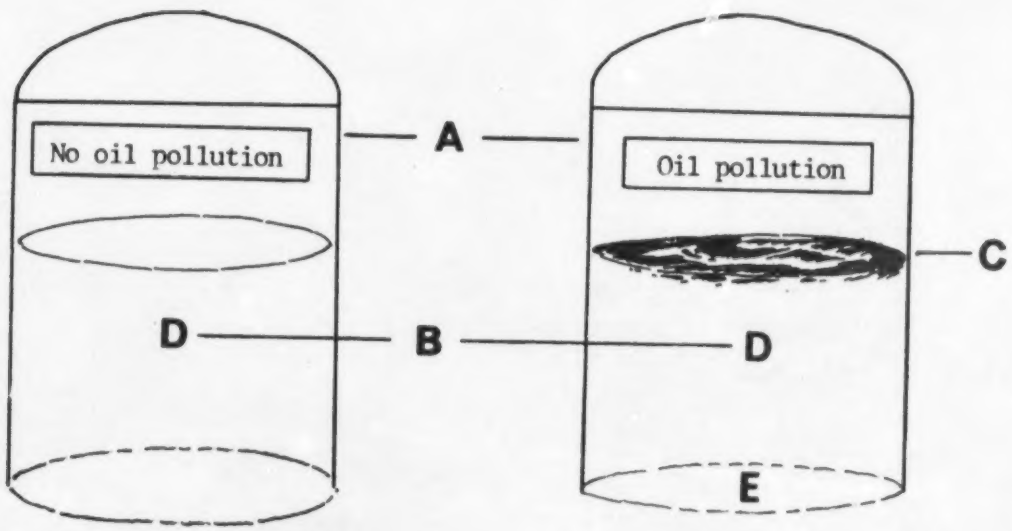
B - equal amounts of clean water

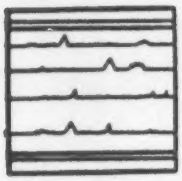
C - 1 teaspoon of automobile oil

D - about 20 Daphnia (water glass) for each jar - the populations should be equal in each jar.

E - a little fish food

F - one eye dropper



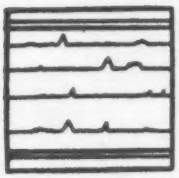


Procedure:

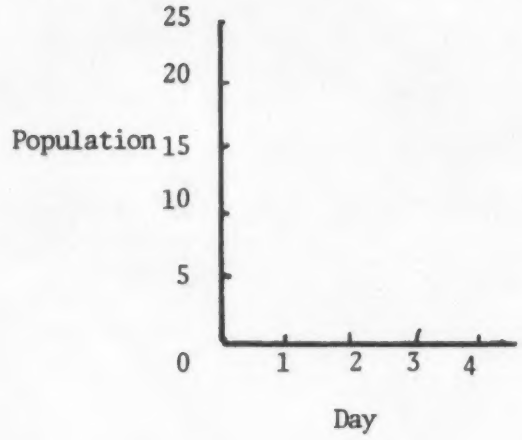
1) Wash both battery jars to get rid of all unwanted chemicals.
2) Place the same amount of fresh clean water in each jar.
3) Sprinkle fish food in each jar. Let the food settle to the bottom of the jar.
4) Add the same number of Daphnia to each jar. If you have trouble catching them use a small eye dropper and just suck them inside the dropper.
5) Add about one teaspoon of oil to one of the jars and label the jar "oil pollution" Label the other jar "no oil".
6) The next 3 to 4 days count the number of Daphnia in each jar and put the number in the table below.

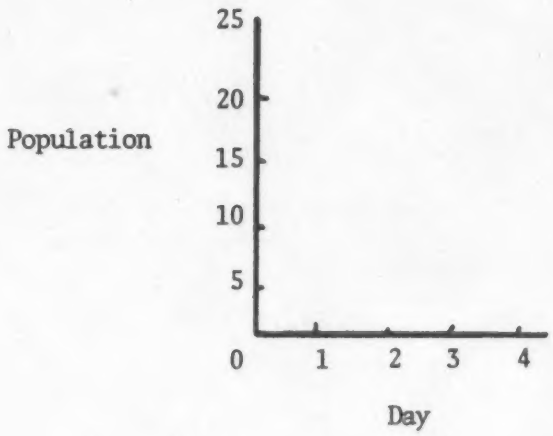
Caution - Do not put the jars in the direct sunlight.

Day	No Oil Population	Oil Population
one		
two		
three		
four		



At the end of the experiment, graph the results from the data table.



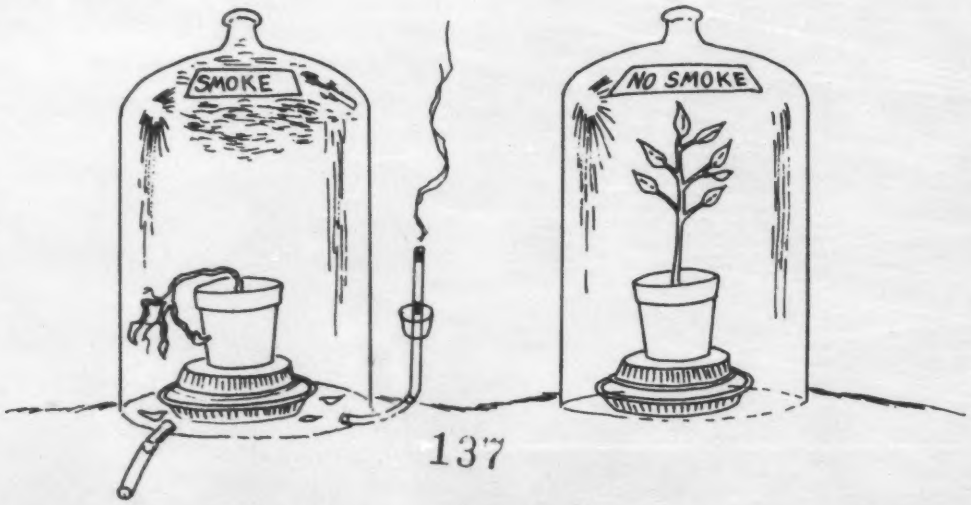


Air Pollution

Hans Flores runs a small, but profitable, nursery that rents plants to restaurants. In the rent agreement, he has to take care of the plants. He has found that many of his plants are having to be replaced because they are turning brown or dying. Mr. Flores thinks it may be cigarette smoke. He doesn't know how to check and he doesn't normally work with the environment in this way.

Hans checked with a friend of his, Cynthia Polk. Cynthia is a plant pathologist. Plant pathologists do research into the nature and cause of plant diseases. She tried to isolate the cause and find a treatment to control the problem. Cynthia is very interested in the effect of the environment on plants. She decided to do the following experiment to see if cigarette smoke had an effect on plants.

Cynthia placed two bean plants under two large jars and gave them the same amount of sunlight and water. In one jar was the control plant and she called "Smoke", Cynthia suctioned cigarette smoke about once every hour during the day.



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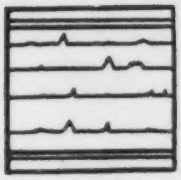
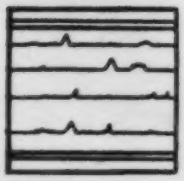


Cynthia observed each plant at the beginning of each day for two weeks. She wrote her observations in a data table so she would be able to remember what had happened during the experiment.

Cynthia's Data Table

Day	OBSERVATION OF PLANT WITH	
	NO SMOKE	SMOKE
1	Plant green & healthy	Plant green & healthy
2	" " " "	" " " "
3	" " " "	" " " "
4	" " " "	" " " "
5	" " " "	Brown spots on several leaves
6	New leaf forming	Plant healthy; has brown spots
7	Plant green & healthy	" " " " "
8	" " " "	" " " " "
9	" " " "	Brown spots increasing
10	Buds forming	3 leaves are dead
11	Buds are blooming	No buds or blooms
12	Plant green & healthy	8 leaves are dead
13	" " " "	Plant is dead
14	Plant has grown	" " "



Interpreting the Data

Using the observation in Cynthia's experiment interpret what has happened by answering the following questions.

1) Does cigarette smoke affect plants? Why or why not?

2) Why did the experiment use one plant with smoke and another plant without smoke?

3) Is smoke harmful to the environment? What evidence do you have to support your answer?

4) Is this experiment just like the real world? Why is this so?

5) Do you think all plants will be affected by smoke in the same way as the plant in this experiment? How could you prove that your statement is correct?

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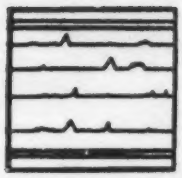
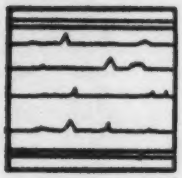


6) Does time have any effect on this experiment? How? What about air pollution in the environment?

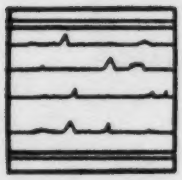
7) What does a plant pathologist do?



Interpreting your Data

Answers

1) From the experiment smoke does have an effect on plants.
2) One plant is a control so that other plants may be compared to the control plant in observations.
3) Answer may vary depending on experience. The evidence is the experimental result.
4) This experiment is artificial but is designed to measure only one variable. In the real world, many variables are present.
5) All plants will not be affected in the same way. Some plants may be affected to a more or less degree than the plant use in this experiment. Use different plants to duplicate the experiment.
6) Time is the rate of exposure the plant has to the smoke. The longer the time the more likely damage to the plant will result. The same is true for the environment and air pollution.
7) Plant pathologists do research into the nature and cause of plant diseases. The work helps to solve environmental problems involving plants by finding methods of treatment and control.



Enrichment Experiment In

Air Pollution

This is an optional activity. You may do this experiment and collect your own data just as the Plant Pathologist. You will need the following materials and about two weeks or longer if necessary.

Materials:

two large bell jars or aquariums

four small aluminum pie pans

two absorbent cloth strips (about 10 inches by 2 in.)

two small plants of the same variety and in the same soil.

several packs of cigarettes

clay or putty to seal the jars

two rubber hoses

cork with hole to fit cigarettes

glass rod to fit rubber hose and cork

section pump or aspirator (An aspirator is a device that uses flowing water to form a suction.)

three small wooden blocks to raise bell jar

matches

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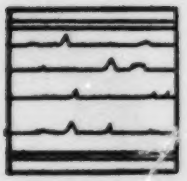

Caution: Do not place plant in direct sunlight.

Procedure:

1) Cut a one-inch diameter hole in the center of two aluminum pie pans.
2) Add water to the two pie pans without holes. Place the pie pans with holes upside down on the pans with water.
3) Place a strip of cloth in the drain hole on the bottom of each plant holder, leave about 3-4 inches hanging out of the bottom of the bottom of the pot so it can touch the bottom of the pie pan.
4) Place the 3-4 inches of cloth into the hole of the pie pan water dish you made. Do this to each plant.
5) Place a bell jar over one plant and seal the bottom edges with clay or puddy. Label this jar "No Smoke".
6) Place the second jar over the other plant but place wooden blocks under the edges of the jar so that the two rubber hose will not be crushed by the jar. Seal the rubber hoses and edges of the jar with clay or puddy. Label this jar "Smoke".
7) Place a short glass tube about half way into one end of a cork that has a hole in it using soap, place the glass tube into one of the rubber hoses. Do not cut yourself.
8) Attach a suction pump or aspiration to the other hose.
9) Place a cigarette into the end of the cork. Be sure it is well secured. Turn on the suction and light the cigarette.
10) Allow the smoke to fill the jar but be careful not to burn yourself.
11) When the smoke in the jar begins to clear repeat steps 9 & 10.

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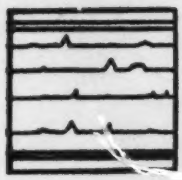
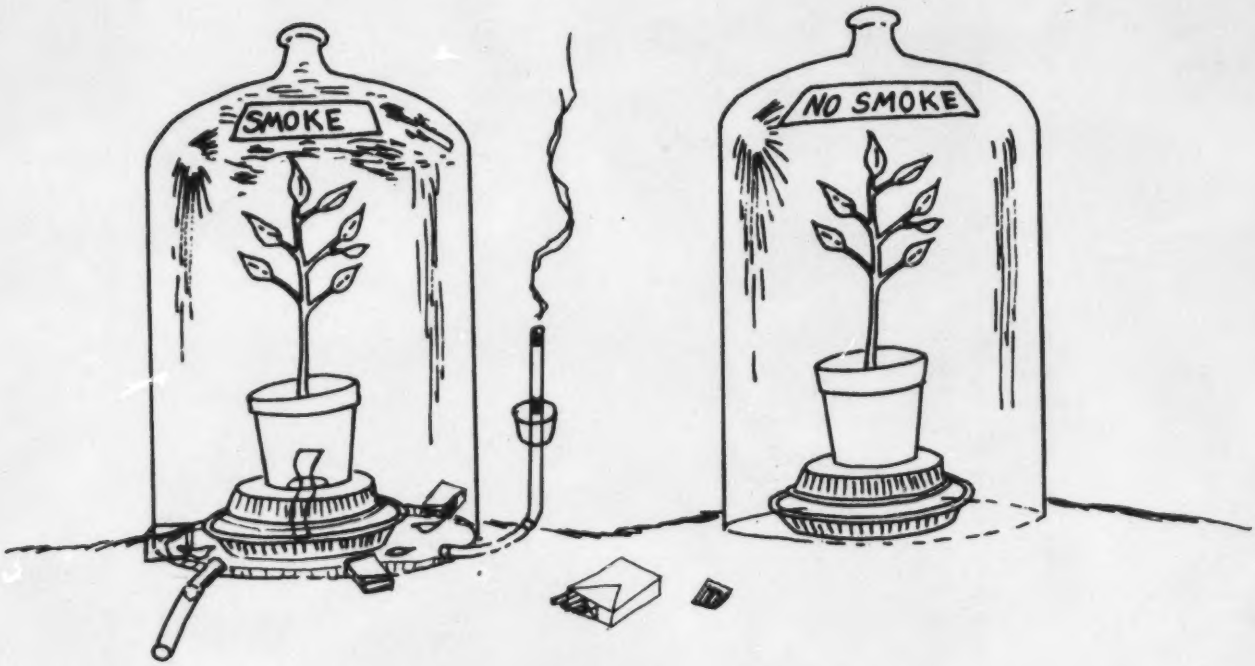
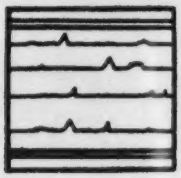


You should use 5 cigarettes each day. This means that you need to do steps 9 & 10 about once ever 2 hours during the day.

12) Do this for two weeks or longer if necessary. Examine each plant at the end of the day. Write your observations in the Data Table.





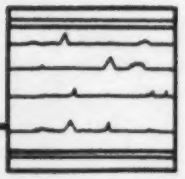
DATA TABLE

Day	Observation of Plant With	
	No Smoke	Smoke
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

HOME and COMMUNITY

Students may talk with family members or neighbors about how the air, water and land has changed since they were young. Students and family members may also tour their local community and try to find examples of pollution.

The class may wish to work together and clean up the litter in a parking lot, field, or stream under the supervision of an adult.



EVALUATION

1) Name two careers that work closely with the environment.

   a. _____

   b. _____

2) What effect(s) does an oil spill in the ocean have on the food chain?

   _____

   _____

3) What effect(s) does air pollution have on plants?

   _____

   _____

4) Mark T for true statement and F for false statements.

   _____a. Graphs make data easier to understand.

   _____b. Just one experiment will explain the answer to any problem.

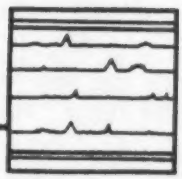
   _____c. When doing an experiment, you always need one object to do the experiment with and one to compare to the experiment to see any changes.

   _____d. Data that is obtained from an experiment is always easy to understand.

5) How does time effect data in a pollution experiment? _____

   _____

   _____



EVALUATION

Answers

1) a. Fishery Biologist, b. Plant Pathologist.
2) The food chain will be disrupted causing a general decrease in food suppliers throughout the food chain. Accept any logical answers.
3) Plants may die, lose their leaves or brown spot.
4) a. T b. F c. T d. F
5) Pollution is a function of time. The longer pollution is present the more chance an effect will be seen in an experiment. Accept any logical answers.